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THE NATIONAL ELECTRICAL EXHIBITION.

That the electrical exhibition to be held in New York during the month of May will have a success in keeping with the great industry which it will represent, seems now most probable. Were it confined to the magnificent exhibit which the New York Edison Illuminating Company has now in course of preparation, the interest it would offer should be sufficient to assure its success, and with the score or more other distinct attractions already assured, it would not be surprising if the enormous success of the recent bicycle show were duplicated. The Edison exhibit to which we refer will exhaustively illustrate the household uses of electricity, including its application to cooking, heating and decorative illumination, and include specimens of various systems of interior wiring and an exhibit clearly explaining the system of street mains, etc. For the technical visitor there will be engineering exhibits of interest relating to the various stations. The Hammer historical collection of incandescent lamps, unrivaled in the world, will be on view, and telephony in its various aspects will be made familiar to all. Arrangements, we learn, are being made to have a complete apparatus to illustrate the new shadowgraphy, and, if the art is then far enough advanced, a "shadowgraphic gallery" will enable visitors to "have their bones took." All connected with the electrical industry should add their efforts to make the exhibition complete in every respect, for the object of familiarizing the public with the accomplishments of electricity is a worthy one, while the technical attendance should result in a direct value to the exhibitor. The fact that the enterprise is a commercial one as far as the management is concerned, should have no unfavorable influence upon lending assistance. The bicycle show and other similar exhibitions have been purely commercial in this respect, but that did not affect their value, either to the public or exhibitors. In view of the great success of recent exhibitions in New York City a failure in the present instance would be peculiarly unfortunate for electrical prestige. Happily, there seems to be no probability of such an eventuality, yet all should lend their collaboration in order to reduce it to an impossibility.

RAPID TRANSIT FOR NEW YORK CITY.

During the past week the perennial rumor was again current that the Manhattan Elevated Railway Company had finally decided to replace steam with electricity on its lines. The rumor had several variations, the difference consisting in the name of the electrical company which was to secure the contract. While there is little doubt but that electricity will finally be adopted for the elevated lines, the present report appears to be merely one of the constantly recurring rumors which frequently have their origin in a desire for publicity on the part of rival interests, in connection with the equipment of the road. In this instance what benefit was to be derived from this sort of publicity was about equally divided, as each of the several rival electrical companies in turn had its name mentioned as the fortunate one who would secure the contract. The motive power of the New York City rapid transit underground railway was also the subject of discussion during the week. Mr. David L. Barnes, who testified before the commissioners appointed by the courts to examine into the plans, stated that the employment of electric locomotives would save 50 per cent. of the cost of operating the road, and that the cost of 20 express trains of six cars, including one motor car, would be $330,000; of 150 local trains of four cars, $1,720,000; of copper conductors,

$715,000; for equipment of power stations for express trains, $504,000, and for local trains, $1,350,000; making a total cost for the electrical equipment of $4,649,000. Mr. Barnes calculated the rate of speed at 40 miles per hour above Franklin Street and, on account of the numerous stoppages, at but 17 miles per hour below that line. Bearing on the same subject is a long interview with Mr. Frank J. Sprague, published in the *Evening Post* of Feb. 8. Mr. Sprague considers that the demands of underground roads with respect to electric traction are less severe than presented by the elevated roads of New York City, but he does not believe that any system yet proposed is the best. What he considers to best meet the conditions consists, not in the employment of electric locomotives, or of a single motor car to a train, but in the equipment of each individual car with its own motor or motors, means to be provided for controlling any desired number of cars, coupled in any sequence, from either end of the train or from either platform of any car. Each car would be equipped with a 50-hp motor, geared for high speed, and the motors of the several cars of the train simultaneously controlled from any one of the duplicate controlling devices that would be installed on the two ends of each car. Current would be supplied by a continuous rail contact, using either a side or middle rail, slightly elevated, or a rigid overhead rail. The current would be generated at two or more power stations situated at the water's edge, and supplied at a potential of 600 or 700 volts for distribution by underground feeders. Storage batteries at three or four local centres of supply are recommended to take care of fluctuations in demand for current. Two power-stations are declared all that would be necessary, each to be equipped with four—or at most, five—3000-hp units. The system includes block signals. Mr. Sprague states that not a single element in the system proposed is problematical, or concerning which there need be any doubt carrying weight against a system requiring electricity as a motive power. We thus have two systems of electric traction offered with a view to adoption for use on the coming underground road, each developed in detail by men entirely competent to deal with the subject. That of Mr. Barnes has had the advantage of successful trial at Baltimore and Chicago under conditions somewhat similar to those which would be met in New York. That of Mr. Sprague introduces only one new feature—that of control—and as the problems which it involves do not practically differ from the similar ones which he so successfully solved in connection with the control of the electric elevator, a practical demonstration on this one point is only needed to place the two systems on the same footing for final judgment.

THE RÖNTGEN RAYS.

Judging from the columns of matter appearing daily in the newspaper press concerning the great discovery of Prof. Röntgen, professors and others fortunate enough to command the necessary apparatus, have temporarily abandoned every other duty in order to devote themselves to the entrancing study of the new form of radiation. Edison himself has been having a severe attack of the Röntgen mania. The newspapers having reporters in attendance at his laboratory did not suffer for copy, as the yards of sensational matter printed emanating from this source attest, and we learn that last week Mr. Edison and his staff worked through 70 hours without any intermission, a hand-organ being employed during the latter hours to assist in keeping the force awake. While numerous shadowgraphs have been taken, no notable advance in knowledge can be said to have been achieved beyond Prof. Pupin's discovery that internal electrodes in vacuum tubes are not necessary; the demonstration of Prof. Wright and others, that bullets may be unerringly located in the flesh by means of shadowgraphs; and, according to a Berlin cablegram, that such pictures show every abnormality of bones in the human body, whether caused by bacteria, disturbances of nutrition or morbid growths. The enormous importance of the role which shadowgraphs will play in surgery has daily been rendered more clearly evident, and though no experiments have as yet apparently been made to test their utility in detecting flaws in metals, we may expect results somewhat analogous to those found from the surgical experiments. On the scientific aspect of the phenomenon little or no light has been thrown. Dr. Pupin, as stated before, finds that metallic bands external to the vacuum tube act equally as well as internal electrodes. Mr. Edison believes that beyond a certain point an increase in the vacuum is deleterious, and that the thinner the glass of the vacuum tube the better the result. After the rather aimless experimenting now engrossing the attention of most of those who have taken up the subject has lost its charm, attention will doubtless be concentrated upon vital points of the phenomenon. The first of these points would seem to be the study of sensitive films. It is most probable that a film more sensitive than the present ones will be found, for if the Röntgen rays lie beyond the visible spectrum, it is scarcely more than accidental that they affect photographic plates. The search for a film may also assist in determining the place of the rays in the scale of vibrations. At present it seems equally uncertain whether they belong in the visible portion of the spectrum, in the ultra-violet or the ultra-red portion. From their origin, however, and particularly if the vibrations are longitudinal ones, the probabilities are in favor of their being in the ultra-red portion. Another important point to settle is the influence of glass in determining the character of the rays, as one of the hypotheses offered is that cathode rays, by their passage through glass, are modified into Röntgen rays. Experiments with vacuum receivers of celluloid or aluminum should determine the truth of this hypothesis, and the influence of purely cathode rays might be tested by means of the atmospheric cathode discharge between metal electrodes, an account of which phenomenon appears in another column. Still another direction toward which investigation might be turned with profit is concerning the effect of films treated with a fluorescent wash, or deposited upon other surfaces than that of glass. Some experiments have already been made with fluorescent washes, but thus far with no positive result. Among the singular experiments in shadowgraphy during the past week were those of Dr. Pupin and Mr. Crumbie, in obtaining shadow prints from other sources than cathode discharges. In the former instance a shadow was obtained of a key placed on the surface of the ebonite slide of a holder containing a sensitive plate, after an exposure of several hours to the sun's rays; and in the latter instance distinct shadow prints were developed on a sensitive plate when it and an object placed on it were interposed between two metal plates forming the secondary electrodes of an induction coil. It does not follow, however, that the effect in either case was produced by Röntgen rays. In the first case the cause may have been the filtration of light through the ebonite during its long exposure to the sun, and the effect in the second case is analogous to that which has been produced by passing a static discharge through a coin resting on a glass surface—in this instance an image of the coin appearing when the spot where it had rested is breathed upon.

The Indiana Electric Light Association.

The annual meeting of the Indiana Electric Light Association was held in Indianapolis on Jan. 30. Among those present were President J. W. Roney, of Richmond; James and Charles Boyce, of Muncie; D. E. Spraker, of Kokomo; E. H. Andress, Lafayette; J. W. Cole, of Greencastle; Mr, Graham, of Washington, and C. C. Perry, secretary of the Indianapolis Light & Power Company. Much interest was shown in the objects of the meeting, and plans mapped out to oppose hostile legislation.

Atmospheric Cathode Discharges.

A year or more ago, during some experiments made by Mr. Freedman, a tutor in the Department of Mechanics, of Columbia College, with the voltaic arc, Dr. Pupin observed a curious phenomenon, which, however, was not studied at the time. More recently the experiments which gave rise to the phenomenon have been repeated with the result of thoroughly establishing it.

In the experiments referred to, electrodes of iron, copper and brass were employed, of a diameter equivalent to about No. 12 B. & S. gauge. Arcs of various lengths were established, the E. M. F. varying from 50 to 100 volts. At times the arc would be broken and then it was observed that a discharge would immediately take place from the cathode or negative electrode, the voltage jumping up to 350 or more. This discharge had all the appearance of the usual cathode discharge, and, once established, would continue indefinitely. While the arc continued the anode was, of course, red hot; but as soon as the arc ceased and the gas discharge commenced, then the negative electrode became red hot and the positive electrode became dark. Further experiments, we understand, will be made to determine if Röntgen effects can be obtained through this phenomenon.

Reissued Patents.

Mr. D. Walter Brown, in a letter to the *Albany Law Journal*, refers to a recent decision of the United States Circuit Court of Appeals, which, he says, is at variance with the doctrine of the United States Supreme Court regarding the principles governing the reissue of patents. The Court of Appeals held that a reissue granted to correct a blunder in the original patent, by which the original failed to state the real invention of the patentee, was void unless it describes and claims only that as invention which, by the blunder, was described and claimed in the original. The doctrine of the Supreme Court, on the other hand, is that where, by a strictly proven blunder, the patent, as actually issued, did not describe and claim the real invention intended, there the broad equities of the patent law allow a reissue to correct that blunder, and state the true invention, although that invention may be different from the one stated in the specification and claims of the blundering original. For the invention intended by the statute is not expressed in the blundering original instrument as issued, but is that brought to view when the blunder is corrected. Under the broad equities of the patent law, if not under the strict terms of the statute, this correction is permitted. But, being an equitable right, its exercise is subjected to a strict application of the equitable doctrine of mistake and laches. Mr. Brown states that unless the Supreme Court reverses the recent decision or essentially modifies it, an unnecessarily harsh principle will be introduced into the patent law.

The National Electrical Exhibition.

The numerous contracts already closed by the National Electrical Exhibition Company assures the success of this enterprise, which contains so much of interest to all those engaged in the electrical industries. All of the larger companies have taken space and the majority of them have planned features that will be both instructive and interesting to the general public, showing not only the practical applications of electricity, but how results are accomplished, etc.

All the branches are already represented, exhibits of electric lighting, electric railways, telephones and telegraphs being in preparation, as well as displays of electrical supplies. This being the first exhibition of the kind ever given in New York, there appears to be a general desire on the part of all concerned to make its proportions truly representative of the electrical industries.

One of the most attractive and instructive exhibits will be that of the Edison Electric Illuminating Company of New York. This display will occupy a space of over 1000 square feet, and will comprise a complete demonstration of the applications of electricity for domestic purposes. The most improved methods of house lighting will be shown in detail, and electric heating; also cooking by electricity.

An Electrical Heater for Oil Wells.

A Pittsburg electrician has designed an electric heater for use in freshening oil wells, which object has heretofore been accomplished by a charge of dynamite. It is claimed that usually when the flow of oil drops off the cause lies in a deposit of paraffin in the Pennsylvania field, and of asphaltum in the Western field. The electric heater referred to is to be lowered to the bottom of the well and the deposit melted by heat supplied by an electric current.

Rontgen Rays.

During the past week many experiments have been made in college laboratories and elsewhere in obtaining shadow prints by means of Röntgen rays, but the uncertainty in regard to the character of the rays themselves—whether the vibrations belong to the ultra-violet, ultra-red, or visible portion of the spectrum—has not been cleared up.

Prof. Pupin, of Columbia College, has succeeded in obtaining a large number of shadowgraphs, a reproduction of one of which we print elsewhere. The several articles to the left were enclosed in an aluminum case, and the spectacles in a leather case, both receptacles being laid upon the ebonite shutter of the camera slide. Dr. Pupin does not use the ordinary form of Crookes tube, but an apparatus devised by himself in which the electrodes do not enter the interior of the tube. In some cases brass bands placed exteriorly near the extremities of a tube with hemispherical ends, have been used, and in other cases, the electrical connections have been made to pieces of ordinary tinfoil wrapped about the tube near its ends. In Dr. Pupin's experiments a small alternator is the source of the electrical currents, a step-down transformer being interposed between the alternator terminals and the induction coil. The connections of the Crookes tube are not made directly to the terminals of the induction coil, but one of them leads to the exterior coating of a Leyden jar and the other to one side of a spark gap, the other terminal of the gap being connected with the other side of the Leyden jar; the two coatings of the jar are connected to the two terminals of the induction coil. By means of the spark gap, a disruptive oscillatory discharge is obtained, which increases the frequency of the current passing through the Crookes tube in an enormous degree. Among the experiments made by Dr. Pupin was one to test the effect of treating the film of the negative with a fluorescent substance, which treatment appeared to increase the effect, though not so markedly as to permit any definite conclusion to be drawn.

A most interesting experiment was made at Columbia College by exposing to the sunlight a closed negative holder with a key on the ebonite slide. Upon the plate being developed after three hours' exposure, the shadow of the key was very plainly discernible on the plate.

Thomas A. Edison has become much interested in the subject of Röntgen rays. He says that he found after he had secured a certain vacuum in the Crookes tube, all the exhausting beyond that merely involves the use of more electrical power to produce the rays, and he thinks it a mistake to suppose that the highest possible vacuum is necessary to their production. He has produced the best results from ordinary incandescent light globes within which have been introduced two aluminum discs, representing respectively the anode and the cathode; the former is three fourths of an inch in diameter and the latter one half an inch. The cathode disc is firmly fixed in the centre of the bulb, in a position as if meant for a reflector. Mr. Edison proposes to make a vacuum tube 25 feet long in order to determine just how far the cathode disc will project rays. The disc will be at one end and at the other the shadowgraph will be sought. If the whole tube becomes fluorescent, he considers that the experiment will be successful, demonstrating the wonderful radiating efficiency of the cathode.

He considers that incandescent light bulbs are superior to the ordinary Crookes tube, as they are blown at a thickness of only $\frac{1}{64}$ of an inch, and consequently offer less resistance to the exit of the rays. In some experiments to determine the relative resistance of certain metals to the passage of the X rays, narrow strips of hard rubber, celluloid, steel, glass, zinc, aluminum and lead were fastened perpendicularly about one half an inch apart on a piece of cardboard, the card was fastened to the shutter of the slide within which was a sensitive plate, and exposed for eight minutes. The negative obtained showed that the steel was practically impenetrable; zinc, lead, glass and aluminum came next, while rubber and celluloid, especially the latter, offered little or no resistance to the rays. Mr. Edison proposes within a few days to make a shadowgraph of a head to see if it is possible to distinguish the brain in it. As to a suggestion in regard to windows in tubes, he said that celluloid would be the best material.

A cablegram states that a physician in Budapest had been able to take satisfactory shadowgraphs after two seconds' exposure of the plate. At Yale, Prof. Bumstead has taken a number of shadowgraphs; the most notable is that of a frog. In the original photograph, it is stated, that the thigh and leg bones are shown as clearly as though they were placed in transparent jelly.

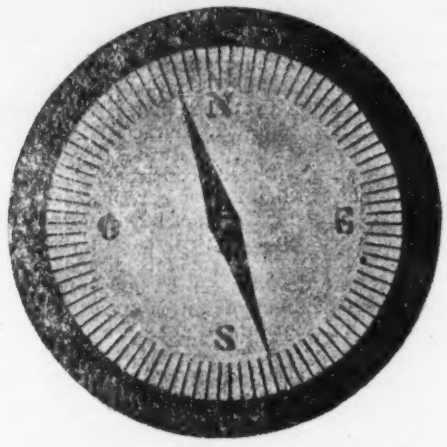
At Princeton, Prof. Magie has succeeded in taking a number of good shadowgraphs; several of the hand, taken behind a thick board, showed the bones very clearly, the flesh leaving merely a shadowy trace.

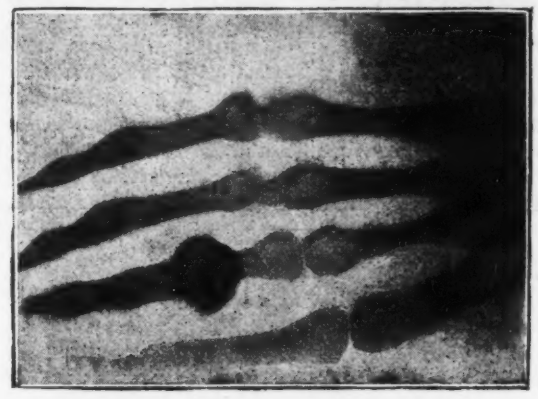
Prof. Trowbridge, of Harvard, has more recently been experimenting with a view to obtaining instantaneous shadowgraphs, or, at any rate, of largely reducing the time of exposure. A Berlin cablegram states that in Germany experiments have shown that the Röntgen rays will differentiate between genuine precious stones and imitations, and that the muscular development of live serpents may thereby be minutely traced. The time of exposure in these cases ranges from three to five minutes.

Prof. Rowland, of Johns Hopkins University, says that while he has obtained certain results, they do not as yet absolutely prove or disprove the validity of Röntgen's theories. He believes there is doubt as to whether or not something else besides the so-called rays of Prof. Röntgen causes the shadows and their action on the plate. In one of the plates obtained the shadow of a key is surrounded in places by curious lines, probably never seen in ordinary photographs, which look like lines of magnetic force.

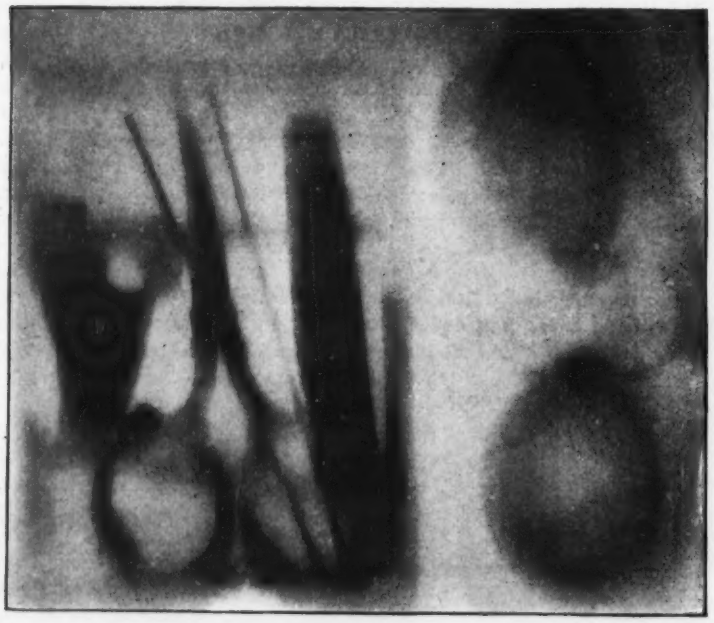
plate were in direct contact with the article. In these cases no Crookes tube was used, the induction coil being directly connected to the metal plates. We reproduce from *Nature* two shadowgraphs made by Prof. Röntgen, which, it will be seen, are surprisingly distinct. A ring on the third finger of the hand shows very plainly in the print. The other illustration is of a compass enclosed in a brass case.

Prof. Wittmann, of the Budapest Technical High School, has succeeded in reducing the time required to obtain a well-defined shadowgraph to three minutes in ordinary cases, and to 30 seconds under very favorable conditions. A professor at the Pressburg, Hungary, Grammar School, with the aid of an imperfect apparatus, obtained a shadowgraph which located a bullet firmly wedged between two bones of a wounded man, thus rendering easy an operation for its extraction, which had previously been prevented on account of inability to locate the ball. A professor of surgery at the Berlin University has experimented with Prof. Röntgen's rays and ascertained that dark pictures of human bones show every abnormality of their substance, whether caused by bacteria, disturbances of nutrition or morbid growths. In the Munich Hospital a man was successfully freed by operation of a needle which had penetrated one of his hands between the fourth and fifth middle bones. It had hitherto baffled all efforts at discovery, but was detected by the new shadowgraphy.

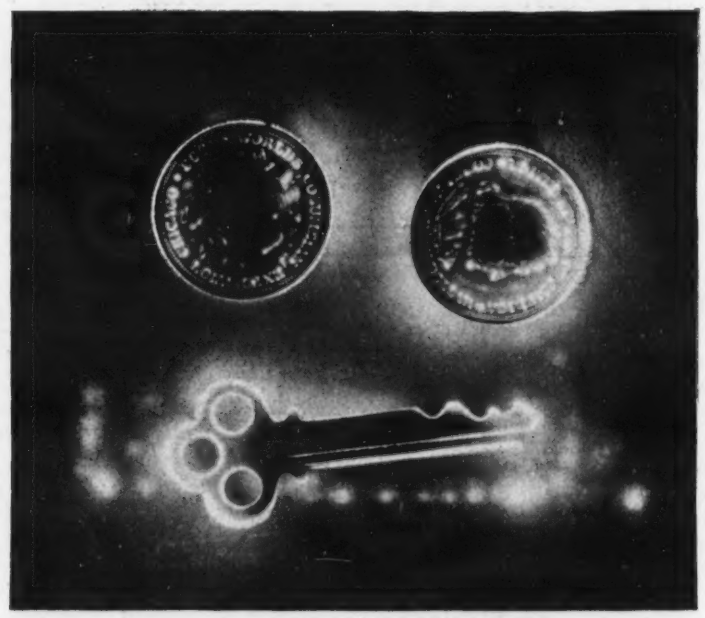




Shadowgraphs Taken by Prof. Röntgen.



Shadowgraph Taken by Dr. Pupin.



Electric Print Taken by Mr. W. D. Crumbie.

Mr. W. D. Crumbie, one of the assistants of Dr. Sherer in the chemical laboratory at the United States Appraisers' Stores in New York, has obtained a number of prints by merely placing a sensitivized plate with an article upon its film between brass plates connected to the two electrodes of an induction coil. The plate is laid on a metal plate on a table, the latter being connected to one electrode of an induction coil, and on the film is placed a coin or other article, over which a metal plate connected with the other electrode is laid. We illustrate a reproduction made from a print of one of these shadowgraphs; others were taken in which the coin was placed in a paper envelope, or was separated from metallic contact with the film and upper plate by a piece of cardboard, the results being scarcely inferior to those received when the film and upper

Prof. Wright, of Yale, among other recent experiments, placed a dead rabbit, in front of a Crookes tube and obtained a fine shadowgraph of the bony structure of the animal. On examining the photograph more closely he discovered a number of small dark spots, and upon carefully dissecting the body, the dark spots proved to have been made by small shot embedded in the flesh.

Mr. Max Osterberg, Fellow of Columbia College, in an article in the New York *World*, of Feb. 8, giving the results of some interesting experiments with Röntgen rays, proposes the name *Skotograph* for the prints taken by means of these rays, *skotos* (σκοτος) being the Greek word for shadow.

Central-Station Working—VIII.

LINE AND STATION EXPEDIENTS AND METHODS.

By E. B. NEWCOMB.

SOON after the installation of lights in a large paper mill it was found that the renewals in certain localities were excessive, the lamps giving out in the filaments after only a few hours' run. Upon investigation these lamps were found to be located near statically charged paper in process of manufacture, or within the influence of highly charged belting. In order to determine with certainty whether this was the cause of breakage, disconnected lamps were held in the hand and presented to the moving belts. After some careless handling, in which the Leyden-jar effect of a lamp was most emphatically demonstrated, it was found that a violent agitation of the filament took place, and in some cases powerful enough to fracture it. How then to make the lamps proof against this influence was the problem. The remedy employed was simple: two or three pointed wires were put about the lamps and connected to the socket, somewhat after the manner of attaching a shade-holder. By connecting the socket-shell, if not otherwise grounded, to one wire of the circuit, a passage was made for the discharge and no further trouble was experienced.

A more weighty problem, however, soon presented itself. The mill in question was at first lighted by direct current, but was afterward connected to an alternating circuit, the transformers being grouped in one locality. There were 1300 lights. As the generating plant was made up of 1000 light factors, two alternators were required for this work. One was given a full load, and the other took the balance, together with a partial load of commercial lights. The main circuits and feeders, both primary and secondary, ran parallel on the same crossarms and structures for a larger part of their length. Everything worked satisfactorily, with one exception; lamps in certain localities at the extreme end of the distributing mains gave an unsteady light. The appearance of these was like that produced by a slack driving-belt slipping at regular intervals of revolution; such, for example, as occasionally takes place in a manufactory near our station, lighted by its own plant, where the effect of a slipping belt is clearly shown by the regular up-and-down movement of the lights throughout the building.

We could not attribute our trouble to this cause, however, as it was confined to only a part of the lights. It did not occur when one alternator only was running, with part of the circuits idle, or even with the latter supplied by direct current from the old dynamos. The frequency of the fluctuations was found to depend upon the

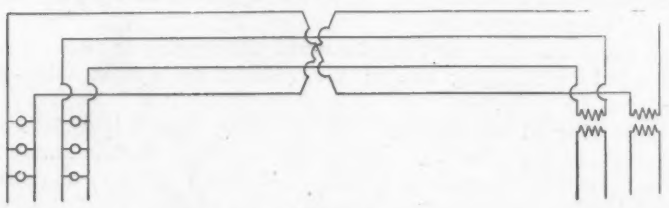


FIG. 1.

relative speed of the two alternators. It was then decided that induction must be the cause of the variation. The waves of current, if not in phase, alternately matched and mis-matched, much on the principle of two piano strings, nearly, but not quite, in unison, making a noticeable wave in the tone produced. A corresponding variation was also noticed in the humming of the alternators at the station. It was clearly evident that induction did not take place in

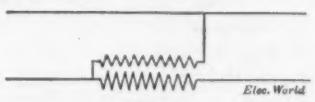
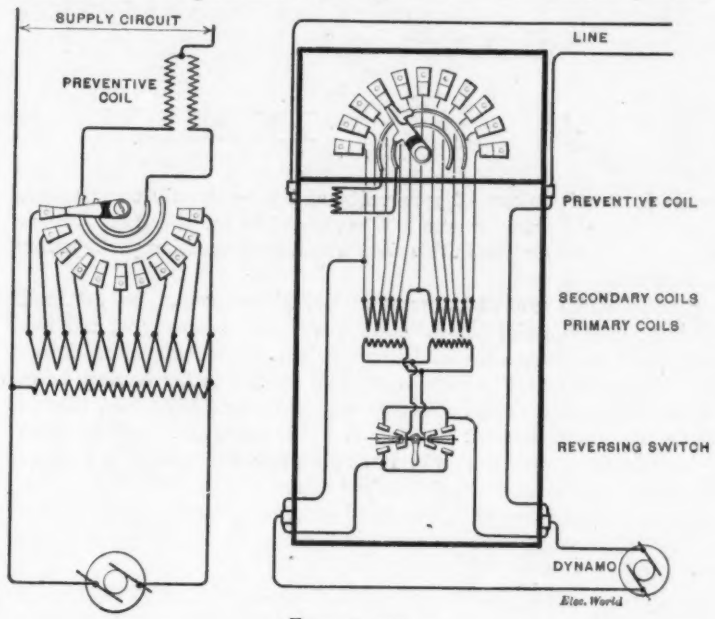


FIG. 2.

the primaries, because no commercial lights were affected. It must then be at the mill, in the secondary mains having the heavier current. Believing this to be the cause, we lost no time in crossing all of the secondary feed-wires of one of the systems at about the middle of their length, as in Fig. 1, and were gratified to find a greater part of the trouble at once removed.

Later, we had a similar experience in another quarter, where the induction took place in the primaries. Circuits from two alternators ran for about a mile upon the same four-pin crossarms. The two inner wires carried 50 amperes of current, while the two outer wires were lightly loaded with the current required for a small number of house lights. Customers upon the latter line complained that their lights had the disagreeable appearance of trembling, as if the filaments were shaken by a jar. Not having any suitable circuit-breakers at hand, we put on an extra crossarm half a mile down the line and, cutting the outside wires, crossed them over. Our customers experienced no further trouble; in fact, they could



FIGS. 3 AND 4.

not detect any traces of the former variation even upon closest inspection.

Our station was first equipped with direct-current apparatus distributing by the three-wire system. Later, we extended our territory and supplied lights by alternating current, at points six miles from the station. So successful has been our experience in lighting with alternators that, were we to begin over again, we would discard direct-current apparatus altogether. The current from an alternator is so easily transformed to required voltages for various purposes that it leaves almost nothing to be desired. By means of additional transformers arranged with the secondary coils in series with the line, as in Fig. 2, the initial voltage can

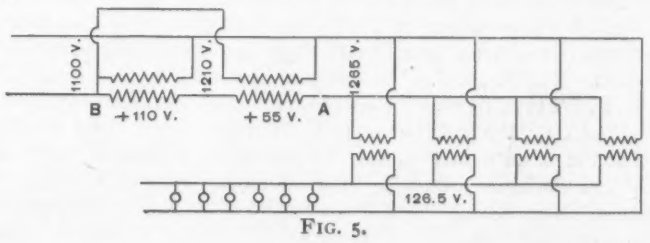


FIG. 5.

be further raised or lowered according to the relative direction of the current through the primary coils.

This general principle is exemplified in the Stillwell regulator, where provision is made for changing the length of the secondary coil, as well as reversing the primary current. With this device shown in Figs. 3 and 4, the voltage can be changed up or down 20 per cent. or a total of 40 per cent., in steps hardly noticeable. By means of one of these regulators, we are able to supply from the same alternator 1100 volts for distribution at a centre one mile away and, by step-up transformers, 2200 volts for service five miles away. With the switchboard adjustment for one of the circuits and a regulator for the other, both branches are easily kept at the proper potential for the varying loads on each.

This step-up principle was put to practical use in transforming for the mill lights previously mentioned. Our standard lamps were 108 volts, while theirs were 120 volts. As a part of their lights were connected to our regular circuits, we found it desirable to retain our standard voltage and transform to that required. Two auxiliary transformers were used, one 1000 to 100, and one 1000 to 50, as in Fig. 5. With an initial potential of 1100 volts, one transformer in-

creased it 110 volts and the other 55 volts, making a total of 1265 volts, which, transformed 10 to 1, gave as a resultant 126½ volts at the switchboard of the mill plant. By connecting the primaries of the auxiliary transformers at *A* instead of *B*, a still higher voltage could be obtained. This would be 1294.1 volts, made up as follows: 1100 *v.* + 129.4 *v.* + 64.7 *v.* = 1294.1 *v.* A still further change could be made by the use of smaller transformers for varying the primary currents of the auxiliaries, or by connecting the primaries in series. Fig. 6 shows how it would be possible to change our

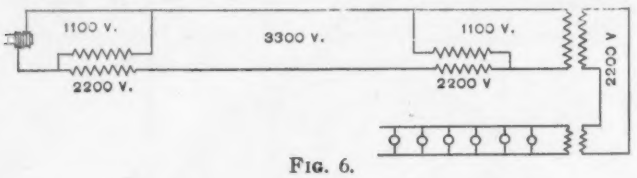


Fig. 6.

2200-volt circuit to one of 3300 volts, and yet use only our present 1000 to 2000-volt transformers. What would be the result of a reversal of the primary wires in this case would be a question perhaps for discussion.

It will thus be seen that a great variety of results can be attained with ordinary transformers without recourse to specially wound apparatus for the purpose. In the cases cited, no transformers larger than 250 lights capacity were used, four of the latter having been connected in multiple, on both primary and secondary wires, to supply the maximum current mentioned. It is the practice on our lines to connect two transformers in multiple whenever one is not large enough for the service. This method allows the adoption of a standard size of transformers, say, 30 lights, for general use, so that a spare transformer or two on hand will serve for replacing any that may give out throughout the system.

In direct-current distribution the system of connecting generators in multiple has long been in use. Series work has not been so common, excepting, perhaps, as it has been found in the well-known three-wire system. That motors can be run either in multiple or in series is perhaps not so widely known. A combination of the two methods in generators as well as in motors, as shown in simple outline in Fig. 7, is rarely found. This represents an existing power

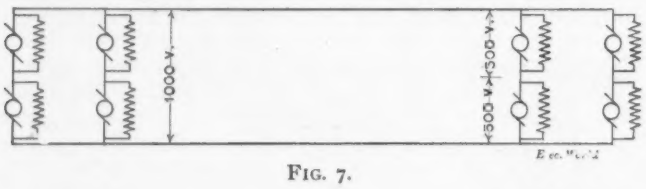


Fig. 7.

plant which has been re-arranged to transmit in either direction. The machines are shunt-wound, the compound winding of the original generators having been disconnected to prevent reversal when running as motors. The E. M. F. of each is 500 volts, making that of the line 1000 volts. The motors and generators are belted respectively to one line of shafting, the pulleys having been proportioned to the relative speed of the armatures running independently as motors, without load. The machines are made to work together by means of field rheostats. No starting rheostats are needed, as either plant can be run at a speed corresponding in potential to that of the other before the connecting switches are closed. The load is taken up by lowering the voltage of the machines desired to work as motors, and raising it at the generator end. The transition from motors to generators is thus easily made, and so smoothly is it done that, on light loads, a comparison of the terminal voltages, by telephone, is sometimes necessary in order to determine the direction of the power.

Electric Vagabonds.

The Germans give the appropriate name of "vagabond currents" to those currents which circulate through the earth in the return circuits of railways.

Classification of Transformers.

Dr. Fleming in a recent lecture stated that there were three kinds of transformers, the mathematician's transformer, the contractor's or manufacturer's transformer—which had a high efficiency—and the real or practical transformer, with all its virtues and vices. Some people, we believe, prefer to divide transformers into only two classes, namely, their own, which are good, and the other fellow's, which are not good.

Economical Results in Modern Isolated Arc Lighting.*

BY F. E. DRAKE.

The plant which is the subject of this paper is owned by J. L. Hudson, the successful clothier, and lights his handsome store in Detroit, Mich. It was purchased in 1891, and installed under the direction and advice of well-known authorities on electrical and mechanical engineering of the University of Michigan. The steam plant consists of return-flue tubular boilers and modern high-speed automatic engines, all well placed, and equipped with devices and accessories for economical operation.

The electric plant as installed consists of five Standard arc dynamos of 40 lights capacity each, 205 Standard double-service arc lamps and a 200-light direct-current 110-volt dynamo wired for full capacity. The plant was formally started Sept. 1, 1891, and has been operated every working day since.

By courtesy of Chief Engineer A. F. Chappell, who has been in charge of the plant since its completion, an itemized account of the operating expenses has been furnished the writer. The record is in detail for the full period of four years and four months from Sept. 1, 1891, to Jan. 1, 1896. Time and space is too limited to show the detailed record for each year, but for a comparative basis the expense for the year 1895 is given.

Detailed Cost—205 Arc and 200 Incandescent Lamps in the J. L. Hudson Building, Detroit.

	For entire period of 4 yrs and 8 mos.	For the year 1895.	Cost* per lamp, 1895.
Coal	$8834.19	$2185.70	$9.71
Carbons	2979.31	618.00	2.75
Labor	14,012.09	3102.43	13.79
Water for boilers	452.09	86.00	38
Soap, soda, mops and brooms	128.76	12.35	06
Cylinder, dynamo and engine oil	1004.28	181.74	81
White waste	165.15	29.82	13
Incandescent lamp renewals	807.85	110.33	49
Incandescent wiring	422.50		
Repairs on boilers and furnaces	794.66	311.33	1.38
Repairs on clutches and shafting	41.85	8.31	03
Repairs and packing for engines	110.26	45.36	.20
Repairs on 205 arc lamps	163 02	85.90	38
Repairs on six dynamos, including brushes	†335.44	30.85	14
Ten per cent. depreciation on boilers, $2000	866.66	200.00	88
Two per cent. depreciation on engines and shafting, $4000	346.66	80.00	36
Four per cent. interest on $6000	1000.00	240.00	1.07
Totals	$32,464.77	$7328.12	$32.56

* The average in the last column on the basis of 225 arcs.
† $200 of this sum was expended in an exchange.

In the item of repairs on dynamos the $335.44 includes $200 expended in changing one of the 40-light arc dynamos into a 50-light.

In arriving at the average cost per lamp, the 200 incandescent lamps are computed as the equivalent of 20 arcs. Each arc lamp is adjusted to 50 volts, and the dynamos being wound for 10 amperes, it will be seen that each arc consumes 500 watts. The following table shows record of output:

	For four years and four months.	For 1895.
Arc lamp-hours	1,527,538	351,658
Arc kw-hours	763,769	175,829
Incandescent lamp-hours	2,735,766	1,038,836
Incandescent kw-hours	150,467	57,136
Cost per kw-hour	.....	.03145

In reviewing the cost per lamp for 1895 it will be noticed that the three chief items of expense are $13.79 for labor, $9.71 fuel, and $2.75 for carbon, figures which are quite phenomenal when the output is considered. Perhaps the most startling figures shown is the extremely low cost of dynamo and lamp repairs. In 1895 the total of dynamo repairs, including brushes, was $30.85, or $5.14 per dynamo. The 205 arc lamps had repairs to the extent of $85.90, or 42 cents per lamp, which covered all globe breakages.

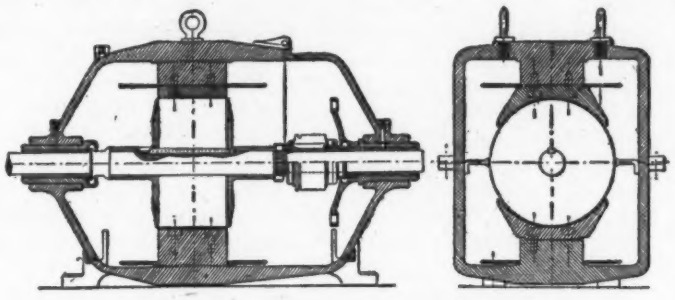
Instead of giving the lighting plant credit for exhaust steam at its estimated value, Mr. Chappell has made the set-off by reducing the depreciation percentage on the engines and shafting, and the interest charges on a sum placed at $6000, which the owner, after several years' experience, testifies to be fair and equitable.

* A paper read at the Milwaukee meeting of the Northwestern Electrical Association.

Data of Sayers Motor.

Below are given some data, extracted from the columns of the London *Electrician*, of the new type of Sayers motor described in our issue of Dec. 14, 1895. In some recent tests of two of these motors, of 12 brake horse-power each, running at 770 revolutions, one as a generator and the other as a motor, a combined efficiency of 80 per cent. was obtained. On a temperature test of three hours the rise of temperature in the magnet coils and armature was 53 degrees and 62 degrees respectively; in a run of six hours as a generator with an overload of 40 per cent., the corresponding rises were 90 degrees and 74 degrees. A load of 17.5 kilowatts was carried for 15 minutes without any signs of sparking.

When running as a dynamo the machine was loaded up to 120 amperes; the load was then suddenly reduced to 80 amperes, when,



SECTIONAL VIEWS OF SAYERS MOTOR.

without change of position, the brushes remained sparkless; on reducing the load to 40 amperes only slight traces of sparking were visible. The rocker was then moved to the sparkless position with 40 amperes, and then all load switched off, when the machine remained sparkless, running light. Copper gauze brushes were used. The following are the data of the machines:

Magnetic Circuit.

—	Area in sq. cm.	$\mathfrak{B}$.	Length cms.	$\mathfrak{H}$ per cm.	Total.
Air space.....	634	7,770	0.76	7,700	5,900
Armature core.....	384	12,800	30	10	300
Teeth max. (roots)...	285	17,200	4.75	100	475
Teeth, min.....	...	....	....	....	....
Field magnets.....	398	13,600	24	12	288
Core limbs.....	425	11,600	90	8	720
					$7,683 \times 10/4\pi = 6,100$ + 10% = 6,700 amp. turns.

*Main Windings.**

Resistance.	Turns.	Size.	Length.	Weight.
0.0385 bet. commutator coils at 120° F.	Two turns per section in adjacent slot, *i. e.*, 2 wires per slot.	0 22 in. by 0.1 in. sc. and bd.	382 ft.	32½ lb.

*The wires forming any armature section lie in slots which are two less than diametrically opposite.

42 Commutator Coils embracing 7 teeth.

Resistance.	Turns.	Size.	Length.	Weight.
0.00406 ohm per coil at 120° Fahr.	Two turns per coil, *i. e.*, 2 wires per slot.	0.1 in. by 0.1 in. sc. and bd.	195 ft.	7½ lb.

Magnet Shunt-Winding.

Res.	Limbs.	Layers.	Turns per layer.	Total turns.	Size.	Current.	Weight.
53 ohms at 1300	2	1	Total turns 3,350.	1,850 turns of No. 18, 1,500 turns of No. 17.	No. 18 (0.049 in.) B.W.G., No. 17 (0 058 in.) B.W.G.	2 amperes.	44½ lb. No. 18 (No. 18 wound on first), 62 lb. No. 17.

The weight of the motor complete is 16¾ cwt.; resistance between brushes at 120° F., 0.0435 ohm; resistance of shunt at 120° F., 53 ohms. The characteristic of the machine is level up to the normal load.

A New System of Telegraphy.

Patents have been granted by the United States and a majority of the foreign countries to Dr. Isidor Kitsee, of Philadelphia, for two ingenious systems of signaling, in which high-frequency but comparatively low-pressure alternating-current is used for transmission, and vacuum globes are employed as receivers. One system is designed for use in connection with ordinary telegraph circuits and cable systems, the arrangement being shown diagrammatically in Figs. 1 and 2.

In Fig. 1 a simple telegraph circuit is shown, *L* being the line, *R*, *R*, the relays, *K*, *K*, the keys and *B*, *B*, the batteries. The

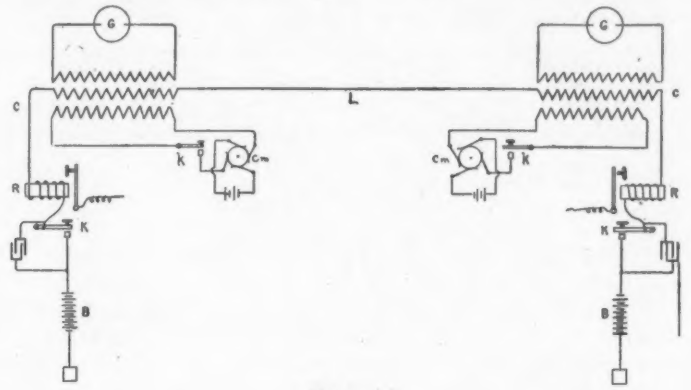


FIG. 1.

local sounders and switchboards are omitted for simplicity. To apply the additional signaling system, an induction coil, *C*, *C*, having three windings, is provided at each station. One winding of low resistance is included in the telegraph circuit; the primary coil circuit includes a signaling key, *k*, a local battery, *b*, and commutator, *cm*, the latter being rapidly driven by a small electric motor not shown in the sketch. The third winding of the induction coil is

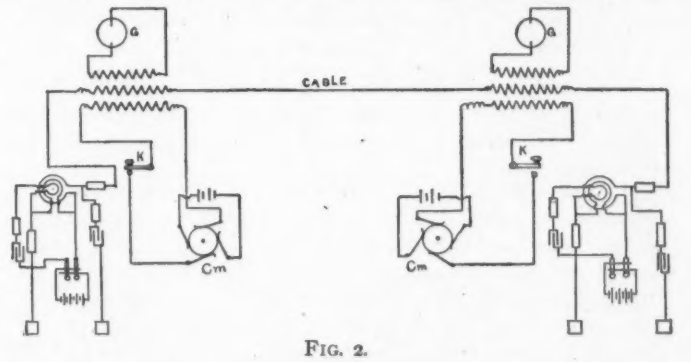


FIG. 2.

in circuit with a vacuum globe, *G*. A condenser is placed in shunt relation to each of the regular telegraph keys, *K*, *K*, so that closing either of the signaling keys, *k*, *k*, will cause the globes, *G*, *G*, to glow whether the telegraph keys are open or closed. The most useful application of the system to land lines is in connection with duplex or quadruplex circuits, which can obviously be equipped with Kitsee apparatus at each way-station, combining the through multiplex and the way-station sim-

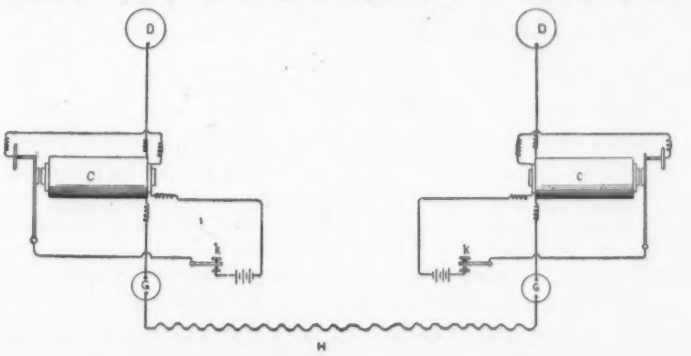


FIG. 3.

plex systems on a single wire. Fig. 2 shows diagrammatically the application of the Kitsee system to a cable circuit. The other of the two systems is more interesting from a scientific point of view. Fig. 3 shows the arrangement of circuits; at each station is an

induction coil, provided with a vibrator in the primary circuit, which also includes a battery and signaling key; one terminal of the secondary coil is electrically connected with the terminal of the distant coil by any suitable conductor, *H*, and the other terminal is connected to one side of a vacuum globe, from the other side of which a connecting wire leads to a copper disc, *D*, which is fixed in an elevated position. Closing either of the signaling keys causes both the vacuum globes to light up. This system is intended for signaling between ships and lighthouses, and between moving trains and stations. In the first case the water of the sea forms the connection, *H*, between the induction coil on the ship and that on shore; in the latter the rails furnish this connection, and a wire strung alongside the track takes the place of the copper disc at the fixed stations, as shown in Fig. 4.

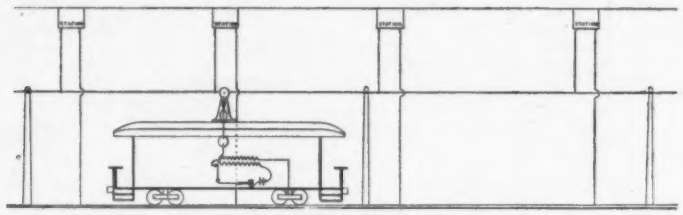


Fig. 4.

The writer was present at a series of tests made recently of both the systems described. In the tests of the railway-signaling system a copper disc, about 6 inches in diameter, was carried on a miniature railway car, and a No. 14 copper wire was hung parallel with the track, so that the distance between the disc and the wire was about 3 feet. One set of apparatus was located on the car, and the other set on a shelf in a remote corner of the room; signals were readily transmitted between car and station irrespective of the position of the former. In the test of the marine-signaling system the connection *H* was made by a trough of water 6 inches wide, 3 inches deep and about 10 feet long, a small copper "ground plate" being used at each end. The two discs were about 8 inches in diameter and 12 feet apart.

Rontgen Rays.

In connection with the discussion of rays in general, and more particularly in reference to the discovery of the so-called Röntgen rays, the following, published in our issue of Aug. 31, 1895, may be of some interest:

"*A New Form of Ray.*—In a recent paper by Dr. Wiedmann, a summary of which is published in the *Zeit. f. Electrochem.*, July 20, he shows the existence of a new kind of ray which is contained in sparks and electric discharges, and to which he gives the name of 'discharge rays.' Many substances in their natural condition show the property of emitting light when warmed; after having been heated they no longer have this property, but it returns again after cathode rays have been directed on them or after having been near electric sparks; he believes the spark acts by virtue of a special kind of ray, and this is the ray which he calls the discharge ray; he shows from experiments that the spark gives rise to such rays, and that discharges in rarefied gases also contain such rays; so far he has not been able to show that the rays are acted upon by a magnet; the form of motion, he says, must be different from that in light, and the results of his experiments indicate the existence of a whirling motion; these rays are very similar to the cathode rays."

Swiss Calcic Carbide.

The Calcic Carbide Works at Neuhausen, Switzerland, have now been in operation more than a year, during which time the carbide has been regularly manufactured as a commercial article. An improved form of the Moissan furnace is used, current being generated by water-power, of which 5000 horse-power is now used, and 100,000 more are available. Twenty to thirty furnaces are ordinarily in use. The carbide manufactured is claimed to yield an exceptionally large quantity of acetylene gas, ranging from 4.01 to 4.81 cubic feet per pound, depending upon the grade.

The price of the carbide at the furnaces at Neuhausen is $124.96 per ton in ton lots; $111.76 in lots from one to five tons, and $99 per ton in larger quantities. The cost of packing is $7.80 per ton additional. The manufacturing facilities, cost of water-power, etc., are said to be exceptionally favorable at the Swiss works.

Dielectric Strength of Oils Under Alternating Potentials.

BY ELIHU THOMSON.

In the course of tests made under the direction of the writer some two or three years ago, the interesting fact was noticed that the striking distances of high potentials in insulating oils were in some way variable with the frequency of the current or potential waves, or upon the time during which electric stresses existed in a given direction through the medium.

This relation has been confirmed by other and later experiments. The general effect was found to be that discharges at low frequencies are capable of puncturing mineral oil layers up to from one third to one half the thickness of an air layer required to just resist puncture by the same discharges, while with high frequencies of equal striking distances in air an oil layer of one thirtieth to one sixtieth of the thickness of the air layer was sufficient to prevent discharges. At frequencies such as 125 per second a potential which would give one half inch spark in air may puncture from one-third to one-fourth inch of oil between the electrodes, while at frequencies of 50,000 to 100,000 a layer of oil of one-fourth inch may resist puncture when the spark in air is as much as eight inches. The high frequencies experimented with were such as were given by condenser discharges over an air gap including a primary of a few turns, with a secondary of a single layer of some hundreds of turns immersed in oil. The discharges, in such case, are not continuous waves, but a rapid succession of oscillatory discharges with dead intervals of periods of inactivity intervening.

The effect of carefully drying an oil was found to increase its insulating power. This was also true to a marked extent when careful filtering was resorted to, a decided decrease of striking distance through the oil with the lower frequencies being observed. It follows from this that all oil used in insulating for high potentials with low frequencies should be kept clean and homogeneous, and free from floating particles.

Variations of temperature of oil did not, in the experiments made, greatly affect the striking distances for a given potential. The general fact, however, that with high frequencies the insulating power of oil layers is, as measured by the striking distance in air relatively to that in the oil, far in excess of such insulating power for low frequencies, seems to be unaffected by the dryness, clearness or temperature of the oil used.

It appears probable, also, that with partially conducting liquids like alcohol and water the behavior with high frequencies is more like that of a true dielectric insulator than with low frequencies. As an interesting fact in this connection, it may be noted that a high-potential high-frequency coil capable of yielding spark torrents of over 30 inches of air gap between its terminals, still maintains its discharges even when shunted by a glass tube one and a half inches in diameter containing ordinary water, and long enough to bridge the gap.

It is difficult to account for the differences in the effects obtained with high frequencies from those with low-frequency alternating waves. A time lag in the establishment of the full dielectric stress or full electrostatic field in the oil might account for the phenomena. According to this hypothesis if two electrodes under oil, separated a certain distance, instantly acquire a difference of potential, this potential would not with equal rapidity strain the oil to the full extent. It might be assumed that the polarization of the oil molecules requires time. Or, it may be that only such part of the electrostatic field as is due to the ether is first established after electrification, and that the increase of such field due to the molecules of the substance, such as the interposed oil, is subsequent to the former.

If this were so the establishment of an electrostatic field at high rates in oils would present analogies with the case of magnetic fields in iron or metals.

It would also follow, if the supposition of a lag as above be true, that in condensers such as those using oil as a dielectric, the capacity would be less the higher the frequency. Again, if any such lag as is assumed exists, it would probably vary with different insulating media, and it may depend upon the molecular state, as viscosity, for example. Observations of the oil space between the immersed electrodes, by polarized light, could probably be used with certain media to detect any differences in time of establishment of electrostatic stress with different frequencies, it being well-known that under high stresses certain insulating liquids become strongly affected in their optical properties, with rotation of polarized beams of light traversing them. If the optical effect noticed should be less in the case of high frequencies than with low rates, it would indicate

a probable lag of the kind assumed. Similar studies using solid dielectrics like glass, mica, etc., would also be desirable. Should the results be negative it would be necessary to attack the problem in some other way.

M. P. Jaret, about a year or more ago, in a communication to the Paris Academy of Sciences, gave the results of his investigation of the properties of mica. He found that it did possess, with rapid oscillations, what might be termed a dielectric hysteresis. Such a property may exist to a more marked degree in oils.

In the tests of the power of oil layers to withstand puncturing by high potentials a curious effect was noticed, which was that discharges under oil passed far more readily between balls than between sharp points. In other words, with any given difference of potential between the immersed electrodes, as measured by the air spark obtainable, pointed electrodes could be brought much nearer than balls without provoking puncture. With balls of one half inch diameter as terminals, and with low frequency (125) potential differences, ranging from 100,000 to 150,000 volts, the space between the points could be one quarter that between the balls. The ratio between the length of spark in air and between sharp points in oil was 10 to 1 at 10,000 volts, and 8 to 1 at 15,000, while with balls these ratios fell to 2.4 to 1, and 2 to 1 respectively. When flat plates were substituted for the balls the striking distance in oil was still further increased as compared with the distance with points. The seemingly anomalous action of points under oil, so different from their action in gases or air, is certainly curious, and the usual injunction to avoid points and edges as conducive to electric discharge does not seem to apply in such media as oil, at least when the potentials are alternating and at ordinary frequencies.

In experimenting with discharges in oil uniform results are only to be obtained by using carefully filtered oil, as ordinarily they contain suspended particles, fibres, etc., which appear to bridge the space between the electrodes and provoke a breakdown due to the non-homogeneous character of the dielectric. It is also necessary to discard oil after arcing has once occurred through it, as it will have become much weaker owing doubtless to the fine carbon particles set free and which remain floating, ready to be drawn into the space between the electrodes, thus giving rise to loss of homogeneity of the medium.

Tests for Fuse Wire.

The following tests of fuse wire were conducted under the direction of Prof. H. W. Spangler at the University of Pennsylvania, on Jan. 17, 1896. Weston instruments were used and connections were made across the lines of a 110-volt and 500-light dynamo. The fuse wires used were of the ordinary commercial grades, some of the wires being the same as employed on the college circuits. The fuses were tested in three different types of fuse blocks.

The first tests were made with a No. 1487 Edison branch block, rated at 30 amperes, and fused with 30-ampere wire. In the first test, 60 amperes were carried for three minutes, and 65, 70 and 75 for one minute each, with no discoloration noticed. In the second test the same block was used, but standing upright and with fuses of the same capacity. Eighty and 90 amperes were carried for one minute, but the fuse was blown with 90 amperes in 45 seconds, with an arc which lasted for four seconds and burnt a hole in the mica covering. In the third test, with the fuse touching the mica, 100 amperes were carried for 12 seconds. In the fourth test, the block was supported face down with the fuse touching the mica. The current was gradually increased to 75 amperes in 22 seconds. In the fifth test the block was on edge, standing upright, and the fuse carried 80 amperes for 20 seconds. In the sixth test a fuse link was employed and carried 40 and 45 amperes for one minute and 44 amperes for two minutes and 20 seconds, the fuse being kept at a red temperature until the current was withdraw. In all of the above cases, fuses rated at 30 amperes were used.

In test No. 7 an Edison link fuse block, No. 61,565, of the main line double-pole type, was used. The block is rated at 50 amperes, and the experiments were made with a 50-ampere fuse, the fuse block resting bottom down. Seventy amperes were carried for 45 seconds, 75 and 80 amperes for one minute each and 85 amperes for two minutes. In other tests, made from 90 up to 120 amperes, the time varied from one minute to one minute and 35 seconds; there was no regularity, the time, for example, being the same—one minute and 10 seconds—for 90 amperes as for 115 amperes, and 125 amperes were carried for two minutes. When blown the arcing was very bad, in the latter case continuing one minute and seven seconds.

Three tests were also made of a Sawyer-Man 50-ampere double-pole main-line fuse block, the fuse carried being rated at 50 amperes. In the first experiment the fuse block was placed upon its side and 70 amperes were carried for two minutes. The fuse blew in one minute in each case with currents commencing at 75 amperes and rising by 5 amperes up to 120 amperes. One hundred and twenty-five amperes blew the fuse in 20 seconds, the following arc lasting three seconds. A mass of molten metal lay in the bottom of the block which should have assisted the formation of arcs. In another test the same block was used with a 40-ampere fuse, rated to blow at 50 amperes. Currents of 50, 55, 60, 65 and 70 amperes respectively each blew the fuse in one minute; at 75 amperes the fuse was blown in 30 seconds, with a slight arc. In a third test the same block had a lengthwise position, a 50-ampere fuse being used. Currents from 75 to 110, rising by five degrees, each blew the fuse in one minute. At 125 amperes, the fuse was blown in 13 seconds, with an arc which lasted the same length of time and destroyed the block.

Storage Batteries.

Mr. Herbert Lloyd, of the Electric Storage Battery Company, read a paper before the New York Electrical Society on Jan. 29, on "Recent Improvements in America and Europe in the Storage of Electricity," giving in part his impressions received from a recent trip to Europe.

In England, he said, one is impressed, not perhaps with the magnitude of the battery installations, but by their number. Private house plants, run by gas or gasoline engines, are abundant, and central-station batteries are being installed as fast as central stations are built. In Manchester, London, and Belfast, Ireland, large central-station batteries have been installed during the past year. In Birmingham, England, a storage-battery road has been in operation some six or seven years, but having been made to serve for experiments for almost all makers of batteries the service, of course, was not of the most satisfactory; since a year ago, however, when the Chloride syndicate got the contract for the equipment of all the cars with its battery, the service is stated to have become entirely satisfactory, and the business a profitable one.

In France the Madeleine & St. Denis road has now been in operation about three years, running some 30 double-deck cars, seating between 50 and 60 people. These cars have run up to this time between two and three million car-miles, and the service has been so satisfactory that Mr. Lloyd believes there is every prospect that all the horse cars in Paris will be replaced with this system. On this road some very good results have been obtained by what the French engineers call "recuperation." The car while descending a 10 per cent. grade can recover by this system 50 per cent. of the energy expended in ascending, and 23 per cent. on a 2 per cent. grade. The limit is 1 per cent. grade, on which there is no recuperation with a traction coefficient equivalent to 22 pounds per ton. If this latter could be reduced to 11 pounds per ton, M. Sarcia states that 23 per cent. could be recovered going down a 1 per cent. grade.

On the Isle of Man the grade of the Snaefell road is almost uniform at 12 per cent., and on this road the car descending the grade delivers back to the battery in the power-house about 33 per cent. of the energy which it consumes in ascending. In Paris the batteries were formerly placed under the seats, but in new cars there will be one box of batteries suspended under the car. Formerly 33 miles were run on one charge of a battery weighing about three tons, but with the newer cars the battery will only weigh about one and one half tons and run 11 miles on a charge, although under good conditions it would be capable of making two such trips. The cars are braked by the charging of the battery. The motors are shunt-wound, always used in multiple, and the starting resistance is inserted in the armature circuit. To attain full speed the field is weakened by inserting resistances. In charging, the battery is thrown onto a circuit equivalent to 2.4 volts per cell, where it is left for three hours, or until the current has fallen from about 90 to 30 amperes. At the end of the third hour the battery is thrown on a circuit of higher voltage, equivalent to 2.55 volts per cell, on which the charge is completed in from one to two hours more, this method avoiding the use of resistances.

An interesting feature in connection with the operation of the above-mentioned road is in the method of repasting the positive plates. The positive support plate is grooved and made of an alloy upon

which there is very little electrolytic action, and by a special process the peroxide which has been deposited on the bottom of the jars in a worn-out cell is repasted into these grooves. Two men are employed repasting and are able to keep some 30 cars in continuous service, so that the cost of this portion of the operation is wonderfully small. A number of these grids was inspected which had run between 25,000 and 50,000 miles, showing no evidence whatever of depreciation. The casting of these grids is carried on by a special process, by which the alloy is cast under very heavy air pressure.

In Germany the Tudor Company of Hagen have, during the past eight years, installed over 5000 plants. An interesting application to street railway work has been made by this company at Hanover, where the cars are propelled by storage batteries within the city limits and run by the trolley outside, the battery being charged without removal, while the cars are running through the outskirts; 44 cars have been installed on this plan. Battery cars are also running in Berlin, Hagen and other German cities, and also in Vienna.

In the past, batteries were made of a practically uniform type and of small size, capacity being obtained by putting many series of cells in multiple. Large units in batteries have now come in use just as large generating units have, an example of this being the battery installed in the Boston Edison Company's station, where each cell weighs about three tons and has a capacity of about 16,000 ampere-hours at 140 volts, with a maximum output of 8000 amperes. The size of a cell can be increased almost indefinitely, and batteries are now constructed specially to suit the work for which they are intended. This is also true of batteries for private house plants, one having been recently installed in New York City with a battery of cells of 2500 ampere-hours each, and during the last three months half a dozen similar plants have been installed, varying in size from 1000 ampere-hours upward.

One feature of the battery business which has received a good deal of attention recently is that relating to the specific gravity of the electrolyte. A plate, four-tenths inch thick, has a maximum capacity when the density of the acid is about 1275; a ¼-inch plate has a maximum capacity when the electrolyte is about 1240. It is very noticeable how rapidly the capacity falls off on either side the maximum point. The mean volts on discharge rise almost regularly as the acid density rises. The rate of discharge being the same per pound of active material, the discharge rate per superficial area is approximately 40 per cent. greater with the thick plate than with the thin.

The battery just being installed in the new Edison station at Twelfth Street, New York, consists of 150 four thousand ampere-hour cells. The positive plates of this battery somewhat resemble the "Tudor" type, the negatives being of the "Chloride" type. There are installed 75 cells on each side of a three-wire system; the 25 end cells on each side are used as regulating cells, being connected by copper bars to four regulating switches, two on each side, so that the battery can be discharged at different potentials.

The battery has a capacity at a ten-hour rate of 4000 ampere-hours on each side; at a three-hour rate of 3000 ampere-hours on each side, and at a one-hour rate of 2000 ampere-hours on each side. The erection of the battery in two tiers, the upper tier of iron frame work, is perhaps new in this country. The insulation of the cells is effected by a special type of oil insulator, which makes this method of erection quite safe. The battery is installed in a room approximately 20 feet by 40 feet, which is, I think, the smallest space in which a battery of equal capacity has yet been placed.

Another Edison station recently equipped is in Lawrence, Mass., where a smaller battery with capacity of about 1500 ampere-hours is in use; this battery is discharged completely in two hours between four and six in the afternoon, during the peak of the load.

High-Efficiency Incandescent Lamps.

To the Editor of The Electrical World:

Sir:—Having noticed an editorial in your issue of Feb. 1 anent the incandescent lamp discussion at the Milwaukee meeting of the Northwestern Electrical Association, I am moved to meet your strictures on the diversity of opinion among the stations as to lamp efficiencies. Opinions vary among station managers because conditions vary. Two factors combined in differing proportions contribute widely divergent results, even with lamps of the same efficiency. These are fluctuation of pressure at the lamp, and the resistance of the carbon of the filament. It is well-known that, given the same conditions of efficiency and constancy of pressure, a 50-volt, 16-candle-power lamp will maintain a better average brilliancy and life than will the 100 or 110-volt lamp. If neighbors are to make comparisons, they should be careful that both start from the same point, and, next, that deductions are made on the same quality (and this item should receive more thought in the future, consideration being given the fact that poor lamps and good ones are much farther apart in quality than they are in price); that the fluctuations of pressure are approximately the same; that the same units of light are employed; that the lamps are of the same efficiency, and that a thorough system of determining the exact causes of lamp-failure is in vogue. A common possession of these points alone makes mutual ground for comparison, and their partial change would, with good reason, vary the degree of lamp efficiency under which various plants should best be operated.

The writer has knowledge of a dozen stations employing 2½-watt 16-cp lamps with excellent results, and yet such lamps would mean ruin if burned on some circuits, where lamps of low economy only can be used. When the conditions are the proper ones, however, these lamps are discouraging factors for the gas companies to contemplate.

There are few, if any, stations which need buy 4-watt lamps to-day (always with the proviso that they *want* something else), if the best lamps are procured, and it should be the business of the purchaser to be properly equipped for ascertaining what are the best lamps.

If any issue is to be taken with station managers, let it be on the ground that many of them do not consider the forward strides made in lamp manufacture during the past few years, and, having found previously that the results with 3 or 3½-watt lamps were unsatisfactory, they declare them to be so to-day, while the fact is that any manufacturer generally recommending 4-watt lamps at this date is simply acknowledging his inability to keep pace with modern improvements.

It would be well to correct the impression that 16-cp lamps can be burned at a higher efficiency under increased voltage, and the maximum of life and sustained brilliancy be obtained. If station managers would ask from the manufacturer a 52-volt, 20-cp, 30-watt lamp, instead of ordering a 50-volt, 16-cp, to be run at 52 volts, a higher class of service could be secured, providing the manufacturer, working understandingly, takes pains to produce a lamp suited to the service the buyer expects of it. Station managers would also serve their own interests better by stating fully to the manufacturers their complete situation, concealing neither from himself nor them derogatory conditions which should be fully and frankly considered, that a lamp best suited to special requirements might be furnished.

New York. Converse D. Marsh.

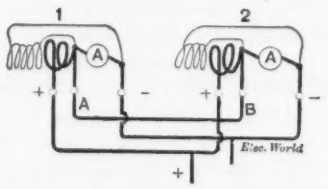
Fly-Wheel Accidents.

To the Editor of The Electrical World:

Sir:—In an article on "Fly-Wheel Accidents" in your issue of Jan. 12, page 80, near the bottom of the page, occurs this statement:

"What is liable to happen in such a case? . . . The series winding would then contain a current flowing in the opposite direction to that of the shunt, . . . etc."

Below is a sketch of two compound-wound dynamos in multiple, with an equalizing wire, *AB*. Suppose, now, that dynamo No. 2



should act as a motor. The current in the series coil *is not reversed*, but remains the same as before, *the armature current only* being reversed.

The two series coils are connected in multiple by the equalizing wire, and are entirely independent of the current in their respective armatures, so far as direction of current is concerned.

A slight speeding up effect might occur, for the following reason:

The resistance of the equalizing wire is usually as large, or nearly as large (sometimes larger) as that of the resistance of the series coil of either dynamo; when one dynamo is running as a motor the entire current for its armature series and shunt coils passes through the equalizing wire. The series coil of the latter machine will then be somewhat weakened relatively to the shunt coils and armature on account of the loss of E. M. F. in the equalizing wire, and hence the dynamo might perhaps speed up a little. J. M. Kent.

Kansas City, Mo.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformer. FLEMING. Lond. *Elec. Eng.* and *Elec.*, Jan. 24.—A brief synopsis of his first Cantor lecture. He pointed out the importance of the core-losses in an interesting way by stating that the energy consumed annually in the cores of all the transformers, connected to the mains of the 47 alternating stations, operating over 1,000,000 8-cp lamps in the United Kingdom, amount at least to about 1,600,000 kw-hours, costing all of $30,000 per year for coal alone. He remarked that it was an entire misconception to talk of transformers as "wiping out ripples" in the curve of a primary as the secondary wave was an exact copy of the reduced scale of the primary.

Sound Castings for Electrical Work. MAY. Lond. *Elec. Eng.*, Jan. 24.—He calls attention to the importance of having sound castings for electrical machinery; this is greatly aided by the fluidity of the metal, to increase which metallic lead or aluminum are often used, but neither gave such good results as ferro-sodium, which increases both the fluidity and brings the whole of the dirt and sullage to the surface of the ladle; its action is to maintain the metal in a more hot and fluid state, and time is thus gained for the purification of the metal; the iron will then be found free from blow-holes or flaws of any kind, and the metal can be filed, turned or otherwise tooled with the greatest facility; he considers it an excellent material for use in magnetic castings for electrical works; he states that the cost is small, and would in no way increase the cost of the castings.

A Dissectible Transformer. CALDWELL. *Elec. Rev.*, Feb. 5.—A brief, illustrated description of two transformers made so that the coils may be quickly removed and changed for others of different windings; they were designed for experiments with a loud-speaking telephone; the capacity is 75 and 150 watts respectively, at a frequency of 125; the iron core is in two halves, as usual, but, instead of being bolted together, it is clamped in a frame, so that it can be readily dismounted.

LIGHTS AND LIGHTING.

Mechanical Vacuum Pump. Lond. *Elec.* and *Elec. Rev.*, Jan. 24.—An illustrated description of the BERRENBERG mechanical vacuum pump for exhausting incandescent lamp bulbs, together with a report of Prof. Ayrton of some tests made with it; the report is published in full in the former journal and in abstract in the latter; the illustrations are not all the same in both journals; (this is the pump which has been used by the Beacon Lamp Company, of this country). In Ayrton's report it is stated that after 15 minutes pumping the pressure in the bulbs, as measured by the McLeod gauge, was one two hundred and fifty thousandth of an atmosphere, and after 20 minutes it was one half of this; he makes comparisons with vacua in commercial lamps and finds that in 21 minutes a better vacuum was produced with this pump than was found in any of the eight commercial lamps examined; no special skill is required in making the glass joints air-tight, these joints having to be made before exhausting each batch of lamps: tests were made of pumping against a leak of some considerable size and it was found that the pump was able to create a fairly high vacuum. He concludes that with the pump examined a vacuum, as good as the best and much better than the worst in the lamps which he examined, can be produced in 15 minutes, and that in 20 minutes a much better vacuum than in any of the lamps tested can be produced; that the system of pipes, cocks, and stoppers is for all practical purposes perfectly air-tight, that even if a leak occurred the pumps are able to work against it until it is remedied; that they are well and solidly constructed, and not liable to get out of order; that the wear of rubbing surfaces will be very slight. The Lond. *Elec.*, in an editorial, states that the tests were evidently not those of one well acquainted with the very crooked ways of lamp vacua; the gauge used is notoriously untrustworthy, and is quite useless in dealing with low-pressure oil and water vapors; the method of opening the lamps under mercury is generally unreliable even as a comparison; as a sealing medium oil is not to be recommended; the cost of pumping lamps is not the serious item in lamp manufacture that many inventors of queer pumps imagine.

Incandescent Lamps. Lond. *Elec.*, Jan. 24.—A note summarizing briefly the results of some tests, the authority for which, however, is not given. They were carried out to find which was the best three-watt lamp. He found great difficulty in getting lamps anywhere near the right efficiency, even when the makers were paid an extra price for special picked lamps; a table of figures gives the average results obtained; he found that makers generally select the lamps by the total watts consumed, regardless of the candle-power, and that the so-called high-efficiency lamps were simply ordinary lamps overrun at the marked voltage, and that these, when run at the normal candle-power, were not better than ordinary 4.5 watt lamps.

Incandescent Lamp Tests. Lond. *Elec. Rev.*, Jan. 24.—A communication from a lamp manufacturing company in England complaining of the tests recently published in that journal, and giving three sets of curves for 15 lamps each of their manufacturer, of 3.1 watts per candle, giving the illuminating power and watts per candle up to 700 and 1000 hours.

The 220-Volt Lamp Question. STEWART. *West Elec.*, Feb. 8.—He states that he and his competitors have installed over 15 central stations in the Northwest, using 220-volt lamps and no others, and that most engineers in that locality are now specifying that system exclusively. Careful experiments covering many months show him that the danger from fire is less, as the danger "is not from voltage, but from current"; the small fuses of the 220-volt system give way at the slightest approach of danger, and sockets spark less; with good workmanship such a system is safer than any other, "and bad workmanship is going out of favor"; he claims that those lamps last longer and blacken less, and that "the reason for this phenomena will readily suggest itself to the expert"; the life of most of these lamps is 1500 hours or over; he believes the 220-volt lamp has come to stay.

POWER AND HEAT.

Zerener Welding Process. Elek. Zeit., Jan. 23.—A long description accompanied by a number of good illustrations showing the various forms of the apparatus as they are used, including also some of the details; the apparatus has been referred to in these columns a number of times (*Digest*, Dec. 21 and 28), and was illustrated in the *Digest*, Aug. 3; the arc is used in connection with an electromagnet, which deflects it, producing a pointed flame like that of a blowpipe. The principle of his apparatus is that when the magnetic lines of force of a horseshoe magnet and the lines of force of the arc cut each other at right angles in a horizontal plane, the arc will be deflected at right angles to this plane in the form of a pointed flame. He has been experimenting with this apparatus for six years, and the present is the outcome of his investigations. He found that by inclining the carbons toward each other, and even when they are parellel under certain conditions, the apparatus may be used without a magnet for working with gold and jewelry in general; he found that the electromagnet had best be connected in series with the arc, the ampere windings having been properly determined, as this simplifies the regulating apparatus; the quality of the carbons is of importance; they may be tubular, having gases or solid substances passed through them; it is very important to have the carbons as hard as possible; the best conditions are different, depending on whether the arc is to be used for welding, melting or soldering and also on the materials to be operated on. For hard soldering the brass is supplied from a wire which is introduced into the flame from the side; a large apparatus for hard soldering takes 18 to 50 amperes at 65 volts; self-regulating apparatus are made for currents from 35 to 250 amperes; for welding sheets 2 mm thick (presumably of iron) 120 amperes at 65 volts are used; the minimum current of the smallest apparatus for soft soldering is less than 3 amperes at 40 volts; the apparatus is constructed for continuous and for alternating currents; as the flame can be brought to any distance from the material, the latter need not be injured, and in this respect it differs very materially from the method in which the material itself is one of the electrodes. The apparatus is already in use in a number of factories, some of which are enumerated.

Electric Power for Plowing. Elek. Zeit., Jan. 16.—A brief note stating that trials were recently made at Rostock, Germany, in which an alternating current of 2000 volts from a central station was used, and transmitted to the field, 3.5 km distant, where it was transformed down to 220 volts; two electric motors were used and they transmitted the power to the plows by means of belts; the power required varied between 25 and 28 hp; the experiments were said to have been very successful; no further data or description is given.

Power Transmission at Niagara. DUNLAP. *West. Elec.*, Feb. 8.—A brief description, with illustrations, of the projected plant of the Niagara Falls Hydraulic Power & Mfg. Co., the water for which is supplied from the present surface canal. The turbines and dynamos will be placed at the foot of the gorge near the level of the lower river; at the start four wheels will be installed of a total capacity of about 7000 hp; the head of

water is 210 feet; each wheel will be connected to two generators, and the power of three of the wheels will be used by the Pittsburg Reduction Co. in the manufacture of aluminum; the fourth is to be used with two 560-kw generators for a direct-current of 500 volts to be used for railway and other purposes.

TRACTION.

Earth Return Currents. Kapp. *Elek. Zeit.*, Jan. 16.—A reprint of a short paper in which he suggests a method for diminishing the "vagabond" earth currents of electric railways. To insulate the rails would prevent the earth currents from interfering with instruments in laboratories and also prevent disturbances on telegraph and telephone lines, besides preventing electrolytic action on gas and water pipes; but to carry this out would involve great difficulties; it is questionable whether it would be possible to insulate them permanently; furthermore, the voltage of the rails might become impaired; if this amounts to 10 volts it would be dangerous for horses and it might become high enough to be dangerous to passengers; such a plan would therefore not be practical. To use the return feeders reduces the rail current only very little unless the joints become bad, and in that case there will be considerable difference of potential between the earth and different parts of the rails, which might become dangerous for horses; to obviate this the return feeders would have to be abnormally large. According to his method, the earth currents may be reduced by keeping the difference of potential between the rails and the earth as small as possible; the current taken by return feeder of relatively small cross-section can be greatly increased by placing an E. M. F. in the circuit of the return feeder, which acts, so to speak, to suck the current from the rails; this E. M. F. can be produced by storage batteries or small dynamos. He gives a numerical illustration; in each of the return feeders a generator would be inserted whose field would be excited by the current in the respective positive feeder, the object of this form of excitation being to make the sucking action of the generator proportional to the momentary currents in the rails, as nearly as possible.

Earth Return Circuits. Rasch. *Elek. Zeit.*, Jan. 16.—He discusses mathematically, with the aid of diagrams, the subject of return currents from railways. He mentions the proposition of Prof. Elihu Thomson in which low-voltage dynamos driven by electric motors are placed at different portions of the line, and so connected in the return circuit that they "pump" the current out of the earth into the rails, that is that they introduce a counter E. M. F. in the currents tending to go from the rails to the earth. He then endeavors to suggest a practical form in which this system can be carried out, and precedes it by a mathematical discussion. He shows that copper return circuits, unless very large, will take off only a small portion of the current from the rails, and that a small E. M. F., together with a comparatively thin return wire, will be very effective; such a wire must be insulated or must be an air return line; he assumes that the resistance of the rails are practicably negligible as compared with that of the copper return circuits; instead of using a number of dynamos at different voltages it is much simpler to use a single regulating dynamo for this counter E. M. F. and adjust the resistance of the various return feeders; he shows that the current in the return feeder is independent of the movement and current consumption of the cars; he shows that the power at the station is increased only 0.7 per cent., and is therefore negligible; that the copper in the return feeders is less than that now usually used; in order that the return currents increase and decrease with the total currents, the total current, or part of it, is passed through the magnet winding of the regulating dynamo. He believes this would be a practical system; the three-wire system has often been suggested as a means to reduce these earth-return currents, but it involves difficulties; the present method, however, is a three-wire system, one side of which contains the small counter E. M. F., the rails being the neutral, and involves no difficulties even on single lines.

Accumulator Traction. Elek. Zeit., Jan. 23.—A brief description of the car which is at present in use in Berlin; the road is particularly favorable for accumulator traction, being almost free from grades, and the rails are in the best condition. The following figures are given on the authority of the editors of that paper: for the total weight of 10.7 tons, and a speed of 12 to 13 km per hour, the mean power required was 4.5 kw corresponding to a traction coefficient of about eight kg per 1000 kg, which for street railways is a very good result; the car has a single 30-hp motor, with single-reduction gears; the Fischinger controller is used, but is not described; it is said to be very simple, and enables electric braking to be used; there are two batteries of 62 cells each, and these are connected either in series or in parallel; the current at starting does not exceed 30 amperes; the batteries have five positive and five negative plates three mm thick; they are made of grids filled with so-called glycerate of lead made of glycerine mixed with certain fatty acids; the surface corresponding to each pole is 35 sq. decimetres; the normal discharge current is one ampere per sq. decimetre, but can be increased to twice this, which then represents a 3-hour discharge; the capacities for the mean discharging current of 18 amperes was said to be 400 ampere-hours and at 30 it was said to be 330; the total weight of the batteries is 3300 kg; the positive plates are formed with a current of 3.4 amperes per sq. decimetre in a bath of permanganate of potash containing sulphuric acid; the negative plates are formed slower in the same bath, but without the permanganate of potash. The car is said to be running very satisfactorily, taking but very little current; according to the accumulator company, 21 double trips of 5.1 km each require 144 ampere-hours; the mean voltage is 240, thus giving 320 watt-hours per car km, an exceptionally favorable figure; a charge would therefore run the car for 16 to 18 hours, that is for 170 km.

Sliding Contact System for Electric Railways. Lond. *Elec.*, Jan. 24.—An illustrated description of the horizontal contact-bar system used by Siemens & Halske as a substitute for the trolley wheel. The device consists of a metal frame pivoted and spring-supported on the top of the car, the upper part carrying a horizontal contact-bar 4 or 5 feet long; it is said to have the great advantage over the trolley wheel of insuring permanent communication with the supply line under all conditions, doing away entirely with the frequent interruptions of contact due to the jumping of the trolley, especially on curves, frogs, etc.; objections were raised on account of friction, noise and wear, but the makers claim that the noise is not greater than that accompanying the trolley, and that by making the bar of a special soft alloy the line wire is not only protected, but its lower surface becomes covered with a layer of particles from the softer metal, by which the contact is improved; all the wear is taken by the contact-bar, which is easily replaced; in order not to concentrate the wear on a single point of the bar, the line wire is stretched with slight deviations from the axis of the track. A recent improvement consists in adding a U-shaped aluminum channel to the wire, which is filled with grease, so as to insure constant lubrication, and it is claimed that thereby all noise is practically avoided, less power is lost in friction, and that the renewal of the bar need not be so frequent; "if the latter claims should be confirmed after long, practical experience, the Siemens apparatus may be expected to replace the trolley in most applications of electricity to traction, and especially where the speeds are greater than usual."

Dublin-Dalkey. Elec. Eng., Feb. 5.—A reprint of the article describing this road mentioned in the *Digest* last week.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

London. Lond. *Elec.*, Jan. 24.—The yearly supplement consisting of a map of London showing, in different colors, the mains laid out by the various leading companies up to Jan. 1.

Cologne. Lond. *Elec. Eng.*, Jan. 24.—The first part of a long, well-illustrated description of this large alternating-current station.

Central Station for Light, Power and Railways. Kallmann. *Elek. Zeit.*, Jan. 16.—A discussion of his paper which was noticed in the *Digest*, Jan. 18. He discusses at considerable length the data for the railways in Boston, which was recently published in this country. Mr. Ross believes that in considering the utilization of an installation one should consider the ratio of the minimum yearly output to the yearly useful output and states that this ratio is not necessarily the same as the mean time of burning per lamp installed, as used by Kallmann; in Vienna, for instance, there are two installations, the mean time of lighting per lamp installed is in both about 600 hours, but the ratio of the maximum current output to the useful output is in one case 1090 hours, and in the other 690 hours, the difference being due to the areas or distances, which are quite different in the two cases, the house front supplied in one being more than three times that of the other.

Diminution of Fire Risks with Electric Lighting. Sc. Amer., Feb. 8.—A reprint of the suggestions offered by the National Board of Fire Underwriters; most of them are already well recognized. Among them are the following: Switch bases and cut-out blocks should be non-combustible; flexible cords should be limited to straight pendant drops and should not be used in show windows; wires should be supported on glass or porcelain and never on wooded cleats, or they should be run in approved conduits; they should not be nearer together than 8 inches for arc and 2.5 inches for incandescent lighting; when passing through walls, timbers, etc., they should always be protected with tubes of glass or porcelain, soft rubber being very dangerous; all combination fixtures should have insulating joints, but soft rubber or any material which will shrink or crack is dangerous; electric gas lighting and electric lighting on the same fixture should be avoided; arc light wires should never be concealed; street railway currents should never be used for lighting or power in any building, as this is extremely dangerous; when possible the current should be shut off when not in use, by a switch placed where the wire enters the building; resistance boxes, regulators, and similar apparatus are sources of heat and should be treated like stoves.

Definition of "Unduly Heated" Wires. Elec. Age, Feb. 1.—Some answers to the question of what is the meaning of "unduly heated" in the definition of the safe carrying capacity of a conductor. Prof. Crocker states that in general it means that the temperature shall not be sufficient to injure the insulation or cause other injury; he considers any heat which is bearable to the hand as perfectly harmless, and that this, though a rough test, is a very safe one; in dynamos and motors the allowable rise is 40° to 45° C., as measured by a thermometer placed against the surface and covered with cloth; in wiring, the most usual standard of a safe current is the number of amperes which, if doubled, will not raise the temperature above 150° F. Mr. Edison says it means that the con-

ductors should not heat more than 212° F., the boiling point of water. Mr. WIENER states that it depends on the point at which the ratio of the energy spent in the wire and the total energy transmitted becomes excessive for the particular purpose, but this ratio varies within very wide limits, depending on the purpose for which the wire is used; figuring the temperature increase from the table of the National Electric Light Association and Fire Underwriters, he finds for bare copper wire the limit of the temperature rise is 72° F., and the final temperature 140° F. Mr. LOOMIS defines it as the temperature which impairs the insulation. Mr. DUNN says it does not refer to the destruction of the insulation, but to a point fixed by experience, which allows for a factor of safety; for wire enclosed in mouldings it would mean, according to the Edison regulations, a rise of more than 18° F.; for dynamos it means a rise greater than 81° F., which is the figure usually specified by engineers and builders. Prof. ELIHU THOMSON stated that the term cannot be defined in degrees; the heat should not increase to a point to endanger the insulation; it is safe to say that when a wire is quite hot to the hand, ordinary insulating materials are on the point of injury; the temperature which a wire will attain depends largely on its location; the circumstances vary so greatly that the only safe rule is to use such a wire as will, under a great variety of circumstances, still remain within safe limits of temperature; fortunately the use of such a size of wire is conducive to the best economy and to saving in the drop on the lines.

WIRES, WIRING AND CONDUITS.

Effect of Temperature and Electrification on the Insulation of Guttapercha. ZIELINSKI. *Elek. Zeit.*, Jan. 16.—A continuation of the article (*Digest*, last week); he describes the tests and the measurements.

ELECTRO-PHYSICS AND MAGNETISM.

Roentgen Rays. BOLTZMANN. *Zeit. f. Elek.*, Jan. 15.—An article of some length giving a discussion of rays in general, and their bearing on the subject of Roentgen's rays; the article is interesting reading, but with the exception perhaps of the last part, contains nothing new; some of the latter parts are of special interest. Ultraviolet rays do not pass through many transparent bodies such as glass, water, etc., and the extreme ultravoilet rays are strongly absorbed in almost all bodies; the ultrared rays pass through a completely opaque solution of iodine in bisulphide of carbon and through completely opaque hard rubber to a considerable extent, but they do not pass through certain substances which are transparent to light. It can be shown that all these waves are transmitted at the same velocity and there is no doubt therefore that they are of the same kind of transverse waves of the same medium, differing only in wave-length; but it is different with cathode rays; Lenard's experiments demonstrate almost conclusively that they are also a wave motion; Roentgen rays appear to be a fifth kind of ray closely related to those of light; they are like the cathode rays in possessing strongly the power of exciting fluorescence, and they are similarly generated, but at the same they are quite different; they pass through almost all bodies while the cathode rays are absorbed in all bodies; both differ from light rays so much that it can hardly be assumed that they are simply light rays whose wave-length is smaller than that of the ultraviolet or greater then the longest Hertzian waves or between the shortest Hertzian and the ultrared. The hypothetical light ether is quite analogous to gelatinous bodies, which are capable of transmitting both longitudinal and transverse waves, and it has therefore been assumed that there are also longitudinal ether waves, although none had so far been found. As neither in the cathode rays nor in the Roentgen rays are there any indications of transverse motion, Roentgen thought his waves might be the long-looked-for longitudinal ones. In all elastic bodies, especially in gelatine, the velocity of propagation of longitudinal waves is far greater than that of the transverse; if this is applied also to the ether, the Roentgen rays may have moderately great length, in spite of their very small period of oscillation; the small oscillation period would explain the excitation of the fluorescence, which is probably strongest when the oscillations are approximately as rapid as those of the molecules; the larger wave-length would explain the property of traversing most bodies, in which they are analogous to the Hertzian waves; he gives as an analogy the fact that the low notes in music which have greater wave-length, pass through walls much better than the high notes; the cathode rays would then be longitudinal waves of extremely short length.

In some editorial notes at the end of this article attention is called to the priority of discovery of Lenard, who in 1894 photographed through opaque pasteboard by means of cathode rays; the paper will be found in the *Ann. f. Phys. u. Chem.*, Vol. 51, page 225, with an illustration; in this he says that cathode rays are photographically active; by means of a long exposure they can show what has heretofore not been noticed, namely, that blackening of the plate will take place behind cardboard; when bands of different metals are laid between the card and the sensitive plate, they will form light spots on the negative which are brighter in proportion to their power of transmission; when the metal was thick the plate was entirely light; the cathode rays therefore actually pass through thick cardboard.

The Lond. *Elec.*, Jan. 24, in commenting on the subject of these rays states that Roentgen strongly favors the theory that the rays are not merely "a very ultraviolet radiation," but are longitudinal vibrations of the ether; Roentgen, Lenard and others appear to have discovered what S. P. Thompson has termed "ultraviolet sound." Comparing the Roentgen with the Lenard rays it is stated that the former are not and the latter are deflected by a magnet; the former suffers far less absorption and diffusion than the latter; the latter fail to pass through anything but the thinnest films, while the former will traverse several centimetres of wood and several millimetres of metal or glass; Roentgen was able to take shadowgraphs and detect fluorescence 200 centimetres from the tube, while six or eight were enough to wipe out Lenard rays in the air; it is thought that these are differences in degree rather than in kind; Lenard rays emanate from the cathode, but the Roentgen rays start from the luminous spot on the wall of the discharge tube at which the cathode rays terminate; a point of similarity is their photographic activity, their rectilinear propagation and the fact that in both cases it would seem the total mass of molecules contained in the unit of volume of any substance practically determines its transparency. It is thought that all things tend to show that we are on the verge of a great scientific discovery which may require us to re-arrange our ideas.

The same journal states that Prof. Mosetig, of Vienna, has made practical use of the Roentgen rays; he made successful experiments on two patients on whom operations were to be performed; the "shadowgraphs" showed with the greatest clearness and precision the injuries caused by a revolver shot in the left hand of a man and also the position of the small bullet; in another case the position and nature of a malformation in the left foot were ascertained; the experiments afforded the means of determining the exact spot where an operation may be necessary. Swinton, in London, found that no effects are obtained when an induction coil is used in the ordinary manner; he used an alternating current with a coil, the secondary of which charged a battery of Leyden jars, the discharge from which was passed through a Tesla induction coil. Prof. S. P. Thompson is said to have discovered that these rays are also generated in the electric arc, and that he has succeeded in getting an excellent shadowgraph.

The Lond. *Elec. Eng.*, Jan. 24, states there is plenty of room between the 6 mm electric waves of Lebedev and the infre-red spectrum, for these rays, and it believes that there are strong theoretical reasons for seeking their place there; on the other side of the spectrum there is unlimited room since there is no known limit to the smallness of light waves. The question of whether it consists of longitudinal vibrations could be settled by any method which would give the rate of transmission. Regarding the priority of discovery it is stated that Mr. Miller in *The Photographic News* claims the honor for Crookes; a serious claim of priority has been made for Prof. Lenard (see above) based on a communication by him in 1894 in reference to photographs obtained from the cathode rays; the claim of Prof. Zenger, of Prague, it is thought can hardly be treated seriously.

Lond. *Elec. Rev.*, Jan. 24.—A note stating that DR. SPIESS, of Berlin, has succeeded in producing even better photographs than those of the discoverer; a good record of a purse through a board two fingers in thickness was obtained in 15 minutes (but with what apparatus is not stated); it was found that all the inequalities that exist in the structure of metals, such as fractures, cavities, etc., can be shown on such photographs.

Longitudinal Light. JAUMANN. Lond. *Elec.*, Jan. 24; abstracted from the *Wied. Ann.*, No. 1, page 147.—He published a law in 1888, which has lately received striking confirmation, and which leads to important conclusions regarding the direction of vibration of cathode rays and light rays; this law is that "vibration, of electric force, taking place at an electrode, and in a direction normal to it, have a specific favorable effect upon the discharge; but, in order to be perceptible, their amplitude must increase with their period. To a first approximation the effect is proportional to the product of the amplitude into the vibration frequency, or, in other words, to the maximum rate of change of the electric force during the vibration. Since only such vibrations as take place perpendicularly to the surface of the electrode have any effect, the orientation of the source is of considerable influence. This has been verified by Wanka in the case of electric waves, and by Elster and Geitel in the case of light." Among the arguments in favor of the view that cathode rays are longitudinal electric oscillations are that these rays are strongest in the axis of symmetry of the discharge space; their intensity is greatest there, and decreases outward, and they are therefore essentially longitudinal, although radial or tangential transversality may be superposed. The existence of longitudinal waves is not admitted by the Maxwell-Hertzian equations; rarefied air has such a peculiar effect on electric discharges that Maxwell's equations cannot be regarded as adequate, the very fact of the discharge contradicts them. Experiments show that the vibration period of cathode rays is of the same order of magnitude as the waves in conducting wires, that is, between 10^{-8} and 10^{-9} seconds; hence they are not ultraviolet rays; if they were transverse without being ultraviolet they would be ordinary light or Hertzian waves, from which they are distinguished, however, by their totally different properties; the longitudinal nature of cathode rays may be proved by Lenard's experiments, in which they were shown to have strong discharging influence when impinging normally on the surface of the electrode, from which it follows that their direction of vibration coincides with their direction of propagation. As soon as μ and k are made variable in Maxwell's equations, longitudinal waves become possible;

he works out the equations in accordance with these conditions, from which the existence of longitudinal rays follows; he explains many of the peculiarities of discharge phenomena, among them the deviation of cathode rays by a magnetic field, and he foreshadows the possible discovery of magnetic longitudinal waves. He also shows that a limited cathode ray contains no transverse components along its axis, but that a radial electric and a tangential magnetic vibration sets in away from the axis, displaced by a quarter of a wave length from the original vibration. Conversely, he shows that transverse rays must always be blurred at the edges, and that even in ordinary air longitudinal lights, displaced by a quarter period, exists at the border of every pencil of transverse light. This theoretical conclusion is completely substantiated by Elster and Geitel's work on the influence of the azimuth and angle of incidence of light upon liquid electrodes. In rarefied air the amplitude of the longitudinal vibration is about one third of that of the transverse vibration.

(The *Digest*, Jan. 11, contained the following paragraph, which is of interest in connection with the above paper: *Cathode Rays.* Poincare. *L'Eclairage Elec.*, Dec. 14.—Jaumann recently attributed cathode rays to longitudinal vibrations of the ether; the present writer shows by means of calculations that this cannot be the case, and that these rays are not propagated in straight lines, but follow the lines of force, and he concludes that the hypothesis must therefore be modified in order to accord with the facts.)

Absorption of Cathode Rays. Lenard. Lond. *Elec. Rev.*, Jan. 24; translated from *Wied. Ann.*, Vol. 56, page 255.—The article is partly of a mathematical character; it is to be continued. Since it was discovered that solid metals were transparent to cathode rays, proof has been obtained of the transparency of other metals also; not only metals, but also probably all solid bodies, are penetrated by these rays, though only when in very thin layers; no single solid body has been found which behaves toward the cathode rays as glass does toward light; gaseous bodies are much more transparent than solid ones, their transparency being measured by centimetres, thus affording an available relative measure of transparency; the transparency of a gas decreases as its density increases; he believes that this relation admits of more accurate determination, and might be extended beyond the gaseous condition into the regions of dense solid bodies; he investigated this quantitatively, finding the power of absorption of each, the general results being with the ratio between the absorptivity and the density of media is approximately constant for the same kind of cathode rays, whatever the state of aggregation of the medium may be, and whatever the material may be of which it is composed. This, however, gives only an approximate expression of the facts; the density and absorptivity vary 10,000,000-fold from the rarest absorptive air to the dense, almost opaque gold; the absorptivity for cathode rays appears to be, like inertia and weight, an expression of the mass of the material, the constitution of the matter, which has so great an influence in the case of light, comes into consideration only in the second approximation. He discusses the subject mathematically, and gives the results of experiments which prove the fundamental assumptions, this forming the bulk of the paper.

Roentgen's Rays. Elihu Thomson. *Elec. Eng.*, Feb. 5.—He considers that Hertz discovered that cathode rays penetrate opaque bodies, and that Lenard discovered that these rays would pass through aluminum when it was made a part of the enclosing vessel, and that after their passage they would penetrate metals and many opaque substances, besides being capable of acting on photographic plates; also that they passed through a vacuum which was so high that no electric discharge could pass, and this led him to believe that it was some effect of the ether. Roentgen has merely magnified Lenard's experiments; it would not be surprising to find that larger and more powerful sources of current would produce far more intense cathode rays, and therefore more pronounced actions at a distance; he suggests constructing a generator for cathode rays consisting of two flat discs of aluminum separated by insulating material, the space between them being connected to a high-vacuum chamber; when these are connected to a source of high-frequency discharges there will be an intense play of cathode rays which would pass out through the aluminum sheets; or a vacuum chamber might be constructed entirely of aluminum with an insulating terminal contained in the space between it and the envelope, if they are exhausted to a high degree while the outer envelope and the one terminal were connected to an electric source. He refers to the publication of Lenard's paper in the Lond. *Elec.*, March 23 and 30 and April 6, 1894 (*Digest*, April 14 and 21).

S. P. Thompson. Lond. *Saturday Review;* reprinted in the *Elec. Eng.*, Feb. 2.—A brief description of the phenomena in popular language. He states that Abney discovered means of photographing the heat waves and succeeded in photographing in a dark room a kettle full of boiling water; it was found that a screen of hard rubber is transparent to these heat waves.

Hall. New York *Sun;* reprinted in the *Elec. Eng.*, Feb. 5. A historical summary of the subject of discharges.—Schuster. *British Medical Journal;* reprinted in the *Elec. Eng.*, Feb. 5. A brief description of the phenomena; in conclusion he states that the fact that the velocity of its propagation is the same in vacua, glass and aluminum, will be a puzzle to mathematical physicists.

W. J. Morton. *Elec. Eng.*, Feb. 5.—He describes and illustrates experiments to find whether similar results might be secured with the ordinary and familiar electric radiations from influence machines and induction coils; he interposed a sensitive plate in its case with objects laid on the case, in the pathway of ordinary electric radiations and obtained two classes of results; first, the interposed and invisible metallic object produces a black image and, second, the same object produces a white image; this refers to the plate, the opposite being true of a print from it; he laid letters cut from sheet copper on the case and held it between the poles of an influence machine to which no Leyden jars were connected, the negative pole terminating in a ball and the positive in a point, the distance between them being six inches, and the box being laid against the negative pole; the "fox tail" or brush discharge extended nearly to the box; after five minutes' exposure the plates showed black letters on a white background (the illustration however, shows the reverse). The same experiment was repeated, using a high-tension induction coil, the primary of which contained Leyden jars and a spark gap; the result, which is reproduced, shows white letters on a black ground. A third experiment, which from the description appears to have been almost identical with the first, gave white letters on a black ground. The results seem to indicate that the copper letters had intercepted the radiations; in conclusion he is led to believe that cathodic rays capable of producing the effects described by Roentgen may be detected in connection with ordinary electric exciters.

The same journal contains a portrait with a short biography of Prof. Roentgen. It also states editorially that Lebon, in France, has succeeded in affecting screened sensitive photographic plates by the rays emanating from an ordinary oil lamp.

Pupin. *Electricity.* Feb. 5.—A brief article on the subject covering partly the same ground as the other articles. He believes that this discovery brings to a close the most interesting chapter in the history of electricity, namely, the chapter dealing with electric discharges through rarefied gases; he explains how these cathode rays may be produced; Crookes' theory was that these streamers represented a fourth state of matter, and that there is along the path of these rays projected matter moving with a very high velocity; other theories were proposed, and the present discovery will probably soon decide which one is correct. The deflection of cathode rays by a magnet is the same as if each ray were a flexible conductor carrying a current with one of the terminals attached to the cathode. The fluorescence in a gas seems to indicate that the cathode rays undergo a diffuse reflection just as though the molecules of the gas were large in comparison to the wave length of these rays. If these rays are longitudinal vibrations of ether, then their velocity of propagation will, in all probability, be much larger than that of light, and therefore for the same period of vibration as that of visible light, these new rays will have a very much larger wave-length; should this be correct, it would be the long-looked-for longitudinal wave in the ether which would avoid the necessity of considering ether "an incompressible solid elastic"; quite a large number of physicists have advocated the theory that cathode rays are longitudinal vibrations; Jaumann's theory (*Digest* above) is an application of Maxwell's electromagnetic theory to a medium whose specific inductive capacity and permeability vary under the action of electric force; such a medium is in all probability a gas in a state of high tenuity, as in the Crookes tube; this theory will not account satisfactorily for the longitudinal character of the Roentgen rays.

Photographs Taken by "Etheric" Light. Elec. Eng., Feb. 5.—Reprints of some photographs taken with Moore's so-called "etheric" light (*Digest*, Nov. 2, 1895) that is, from the light produced in vacuum tubes by high-tension discharges.

Luminous Glow in Rarefied Gases. Elster and Geitel. *Elec. Eng.*, Feb. 5.—A reprint with the illustrations of the article mentioned in the *Digest* last week.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbon Battery. Zeit. f. Electrochem., Jan. 20.—A brief note referring to an English battery states that the carbon electrodes dip into the molten nitrate; the cathodes consist of iron plates, besides the vessel itself; a circulating tube passing diagonally through the liquid from bottom to top contains an injector, by means of which saltpeter may be introduced.

Electrolytic Amalgam. Andreoli. *L'Elec.*, Jan. 25.—A continuation of his article, in which he gives a historical summary concerning the production of electrolytic amalgams.

The Blot Accumulator. Lond. *Elec. Rev.*, Jan. 24. A brief abstract of a paper read before the Soc. Int. des Elec.—D'Arsonval gives his experiences with these accumulators which are of the pure Planté type; the results of tests showed that one element weighing 20 kg gave 200 amperes on short circuit, after which it was recharged and discharged at one ampere per kg; the ampere-hour efficiency was 79.2 per cent. and the watt-hour efficiency 64 per cent.; the plates were in a perfect condition; after being used some time, "capacities of 10 and 12 amperes per kg" were reached; it is stated that they can remain charged for a long time without losing any of their charge; a certain battery remained

"charged" for four months; the efficiencies in ampere-hours at various rates are given, at one ampere per kg it was 89 per cent. and at 5.6, 45 per cent. In the discussion it is stated that with Fulmen accumulators capacities of 18 and 15 ampere-hours per kg were obtained at rates of 1 and 5 amperes per kg, on an electrical carriage.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Protecting Instruments from Return Railway Currents. FROELICH. *Elek. Zeit.*, Jan. 16.—A paper in which he describes and illustrates the apparatus for the method given in his former paper abstracted in the *Digest*, Dec. 14. He believes that it is now possible to protect instruments in laboratories from the disturbing effects of electric railway currents, at least to a certain degree, and that this protection may be guaranteed. In the discussion Prof. Kohlrausch expresses disappointment that the method did not protect whole buildings, but only individual instruments, each of which must be surrounded by certain frames; the process is correct, theoretically; he believes that adjustments will be required frequently, and this will take considerable time, especially as they must be made at night; the trials were made on a newly constructed railway, but on one, which has been running for some tine, he believes the rail contacts would become a variable resistance, and that compensation would then become impossible, which latter would introduce objections to the adoption of the system. Froelich in his reply stated that the adjustment can readily be made by his assistants; he considers it no objection that this must be done at night. Kohlrausch referred to the variation in a single-rail contact, and considers that in such cases compensation would be impossible.

An abstract of the paper, noticed in the *Digest*, Dec. 14, is published in the Lond. *Elec. Rev.*, Jan. 24.

Differential Method of Comparing Direct and Alternating Currents. BOYD. *Elec. Eng.*, Feb. 5.—He describes a convenient method of comparing the two currents in a differential dynamometer; it has a fixed coil for the direct current and another for the alternating current, the moveable coil being common to both currents; the two fixed coils are balanced by connecting them in series, but opposite to each other, and adjusting an auxiliary coil until a current through them produces no deflection. When the torques produced by the two currents are equal there will be no deflection; a double coil may also be used for the movable one, the balancing being all done on the fixed coils, but this requires four connections with the suspended coil.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction Phenomena in Telephone and Telegraph Lines. Elek. Zeit. Jan. 23.—A reprint of the long discussion of the paper of Mr. Muench, (*Digest*, Jan. 25); it is devoted almost entirely to a discussion of the supposed advantages of the Mueller system, which was referred to in the abstract of the paper; indirectly also to the question of whether the disturbances are chiefly due to induction or to leakage currents. Mr. West believes that the different causes act together, and suggests a means for analyzing them and finding the quantitative effects of each; he proposes to use the Froelich method, in which the vibrations of a telephone membrane are recorded photographically; if the disturbing currents are due to induction, then impulsive currents will be produced in the second line, but if they are due to leakage currents, the current in the second circuit will flow as long as, and like the current in, the first current.

Safety Device for Telephone Circuits. ABRAMOWITSCH system. *Elek. Zeit.*, Jan. 23.—A brief, illustrated description of the apparatus which is in use in Russia; it is of the electromagnetic kind; the magnet, when in action, releases a copper spring which flies open and thereby breaks the circuit.

Pacific Cable. Lond. *Elec. Rev.*, Jan. 24.—The result of recent meetings was that the approximate route for the cable is now practically decided upon and it is resolved that the cable shall be owned and worked by the British Government; the colonies have yet to decide on the amounts of subsidies to be provided by each of them.

New French Transatlantic Cable. L'Elec., Jan. 25.—A reprint of the agreement with the government regarding this cable.

MISCELLANEOUS.

Presidential Address. FAWCUS. Lond. *Elec. Rev.* and *Elec. Eng.*, Jan. 27 in full, and Lond. *Elec.*, Jan 27; in abstract.—After a brief reference to electric traction, he speaks of doubling the voltage of three-wire continuous-current systems; at present lamps are made for 200 to 230 volts, which have proved themselves satisfactory when properly made; the best have two or more filaments arranged in series; in this way eight-cp lamps can be made to take 230 volts, and 16-cp lamps up to 400 volts; he warns engineers to be careful about increasing the voltage of the systems; he doubts whether it is true that there is no danger to life from 250 to 400-volt circuits, as the indirect results of such shock might be most injurious, or even fatal, if received by a delicate person, or one in a dangerous position; the types of switches and other fittings commonly in use are totally unsuited for these pressures and the insulation of the wires in the older installations will be insufficient. Regarding incandescent lamps, he states that they are frequently condemned, when the fault is really that they are not properly used; he mentions that a series of experiments were recently made on lamps of most of the leading English and Continental makers, from which he noticed that many lamps beginning with four watts per candle in the course of 100 to 150 hours increase as much as 20 or 30 per cent., and the watts from 15 to 25 per cent., and then gradually fall until the end of their life; he also found that lamps starting with an efficiency of 2.5 to 3 watts showed no rise in candle-power, but a steady and fairly rapid fall up to a critical period of 300 to 500 hours when they reached their minimum efficiency of 4 to 4.5 watts, at which they continued; some of the better lamps averaged considerably over 1000 hours; this would point to the advisability of using a high-efficiency lamp as such for a time, and subsequently moving it to a less important position for the remainder of its life, being content with about its original light. He hopes that in the near future supply companies will sell light, as distinguished from current.

Inaugural Address. HOPKINSON. Lond. *Elec. Eng.*, Jan. 24, concluded; see *Digest* last week; the whole address is reprinted in the Lond. *Elec. Rev.* and begun in the Lond. *Elec.*; it is discussed editorially in the latter and in the *Elec. Eng.*—It is interesting reading, but appears to contain nothing new; the present portion is devoted mainly to showing how the phenomena of electrostatics can be based on those of electric currents as fundamental.

Technical Institute at Darmstadt. Zeit. f. Electrochem., Jan. 20.—A long, illustrated description of the various electrical and chemical laboratories at the high school at Darmstadt, Germany.

The Oldest Electrical Journal in America.

As three different electrical journals have been claiming whatever distinction is supposed to come from being the oldest periodical of its class in America, THE ELECTRICAL WORLD recently gave the facts in a little

First number under title of "The Operator and Electrical World," and first of enlarged size.

pamphlet, so that any one interested might be able to settle the question for himself.

Of course, the matter is not of any particular importance. At the same time, for the sake of historical accuracy, it was better that no room for doubt should be allowed to exist, such as might have arisen had the "claims" of all three been permitted to go unchallenged.

After the publication of the facts one of the "claimants," which evidently could see no way to justify the grandiloquent title it endeavored to apply to itself of "The Oldest and Best of Electrical Journals," declined to pursue the subject further. Like Dunraven, it refused to play; also like Dunraven, it has not up to the present writing offered an apology.

The second of the "claimants," which wanted to go down the ringing

First number under the present and shorter title of The Electrical World.

grooves of change as "The Oldest and Most Influential Electrical Weekly in America," pursued a different course. It tried to brazen it out by asserting that the pioneer electrical journal of America died in infancy, or at least changed its name.

It is not a crime to change the name of a journal. In fact, in a business in which there have been so many changes during the twenty-two years since THE ELECTRICAL WORLD was established it would have been remarkable had the pioneer journal of this industry not changed its name. Both

the other claimants changed theirs, and certainly no one will honestly contend that a change in name, provided there be no change in contents, makes any marked difference in a paper.

The *Century Magazine* not long ago celebrated its twenty-fifth anniversary, yet for considerably more than half that period it was known by another title.

The accompanying photographic reproductions of the headings of THE ELECTRICAL WORLD tell their own story of the change of name.

The first issue of THE ELECTRICAL WORLD was dated March 1, 1874. The accompanying photographic reproductions show how the change in name was made.

The brazen-it-out claimant admits that its first issue was dated Feb. 15, 1882, and that it began its career as a weekly on March 22, 1883.

To say that on March 22, 1883, the present ELECTRICAL WORLD was not in existence, reminds one of the humorist who claimed that he could prove that a certain statement in one of Shakespeare's plays was incorrect. Being asked how he could possibly say such a thing, he justified his criticism by the following process of reasoning: "To err is human; Shakespeare was human, therefore Shakespeare erred."

The logic of such an "argument" as that THE ELECTRICAL WORLD was not established until after March 22, 1883, is on a par with the Biblical jokes about Peter being the smallest man because he slept upon his watch, and Joseph being the straightest man because Pharoah made a ruler out of him.

If journals would devote more attention to their reading contents and less to fine-spun "arguments" to show that contemporaries which did the pioneer work in their line do not deserve any credit for this because changing conditions necessitated a change of name, they themselves and the industry they represent would be much benefited.

Electric Motors on the Manhattan Elevated.

The officials of the Manhattan Elevated Railway, we are informed by the Electric Storage Battery Company of Philadelphia, have, after considerable and prolonged investigation, concluded that a combined system of third rail and storage battery is best adapted to meet the requirements of their road; they have therefore decided to equip the Thirty-fourth Street branch with the system, and feel sanguine that results will justify them in thus equipping all their lines. For this system the following advantages, among others, are claimed:

Greater speed in starting, with less expenditure of energy; less vibration to the structure, for the reason that the power is rotary; electric light and heat in cars; absence of smoke and steam; great economies in coal, cost of operation and maintenance of structure; absolute reliability of service, for either system may be relied upon to carry the train to its destination.

If adopted for all the lines the claim is made that the saving in the consumption and handling of coal will amount to $900,000 per year, equal to 3 per cent. on the capital stock, and the additional saving in repairs and maintenance of engines and in other important items will be equivalent to the interest charge incurred by the change of equipment, the total cost of which will amount to about $6,000,000.

The work of installation will be conducted by the Electric Storage Battery Company of Philadelphia, aided by the General Electric Company. An electric locomotive carrying motors on the axles and a storage-battery plant in the house of the locomotive will be used. The elevated structure will be equipped with a third rail to carry current to the trains. The storage battery on the locomotive and the motor will be connected in parallel with this third rail. Electric current will be conveyed by this third rail to the locomotive from a power-station near the lines.

If adopted for all the lines, the main station will be situated outside the city limits, in order to secure the economy of cheap land and cheap fuel. In this station machinery of large size and the highest possible efficiency will be used, which will generate alternating current at a high tension, which can be conveyed to sub-stations along the lines of the elevated road with very small loss in energy and cost for conductors. These sub-stations will reduce and transform the high-tension alternating current into a low-tension constant current, with which the third rail will be fed.

Electricity on the Brooklyn Bridge.

The first official exhibition of electricity as applied to the switching of the cars on the Brooklyn Bridge was made Feb. 8, at 11 a. m. The motor car was coupled to three of the ordinary passenger cars and the complete train of four cars was switched by the motors from the incoming to the outgoing platforms, and thence to the cable sheaves several times. The car was then taken over the complete bridge circuit twice. Complete satisfaction was expressed by President Howell and Chief Engineer C. C. Martin, of the Bridge, at the manner in which the work was performed.

If the general plan adopted at first prove economical as well as satisfactory, a certain number of cars will be equipped with four motors, one on each axle. These cars are to be known as motor cars and each will remain with its own train at all times, switching it from the incoming to the outgoing tracks and pulling or pushing it over the tilting sheaves, when the grips will take up the cable and the motors cease work. Should the grips slip while the train is mounting the 3.78 grade, the motors can come again into requisition and assist the trains over the summit.

Moreover, during the early morning hours, when traffic has become light, and the cable is no longer running, the trains can be operated entirely by motors cars, as they now are by the locomotives. The eventual outcome may be the exclusive operation of the Bridge railway by these motor cars. Meanwhile they will switch the trains, and as each train is equipped with its own switching power—the motor car—all the interference which the steam locomotives have hitherto placed in the way of the incoming and outgoing trains will be done away with, and the complexity of the switching be greatly reduced. At present the time consumed in switching a train is 20 seconds, and in that interval a vast number of peo le gather on the platforms. With the new motor and the new principle of operation it is expected that passengers will at all times have cars waiting for them. Besides the gain in time in the switching process, all the inconveniences of the locomotives—the noise, smoke, steam and gases—will be eliminated, and this in itself will be no small gain.

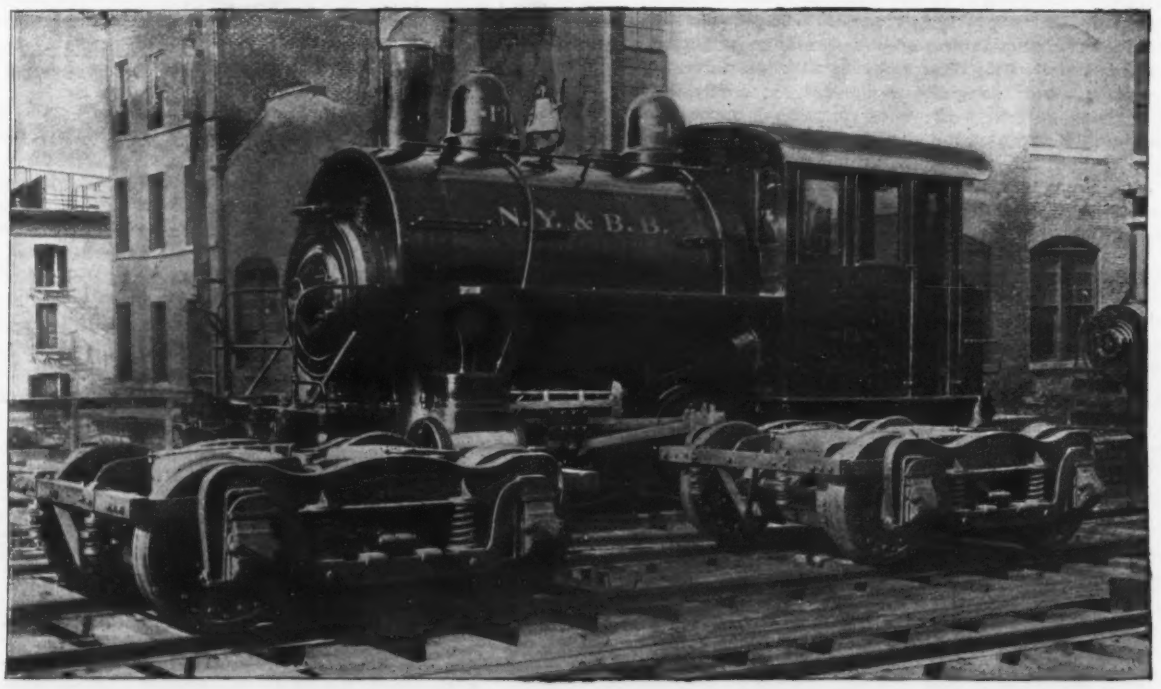


FIG. 1.—TRUCKS OF BRIDGE MOTOR CAR.

One of the regular passenger cars of the Brooklyn Bridge was used to receive the first electrical equipment. All the apparatus, with the exception of the controlling handles and circuit-breakers are placed out of sight beneath the floor of the car. The ordinary light Pullman trucks on

which it has hitherto run and the cable grip mechanism have been removed. Heavier trucks (shown in Fig. 1) carry the motors; these were supplied by the McGuire Company, of Chicago, and combine the best features of the passenger and locomotive truck. The illustration brings out well the compactness of the electrical equipment as compared with a locomotive.

The general character of the motor equipment is similar to that in use on the Chicago Elevated and Nantasket Beach roads. The motors (Fig. 2) are known as the G. E.-1200 from the fact that under normal conditions each will exert a horizontal effort of 1200 pounds, when mounted on a 33-inch wheel. Four of these motors are employed, one to each axle or two to each truck. They are completely encased, and are water and dust tight. The armatures are of the well-known iron-clad type, the windings being sunk into slots in the armature core. The Eickemeyer winding

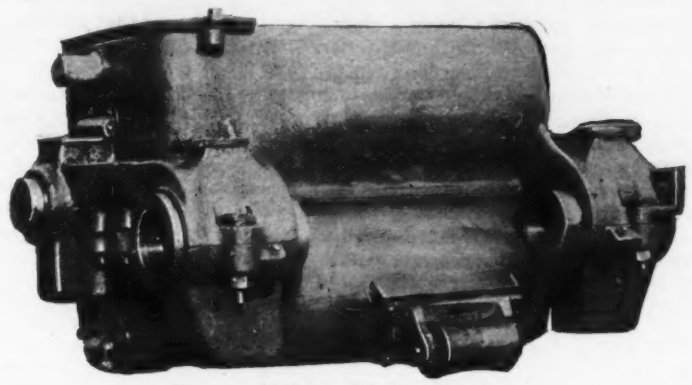


FIG. 2.—MOTOR OF BRIDGE CAR.

is used on the armature. By this method the crossing of two wires of large difference of potential is avoided.

The insulation is substantial, and each segment of the commutator is of hard-drawn copper. The armature is mounted on a sleeve keyed to the shaft, which may be withdrawn without interfering with the armature structure. The field-frame is of cast steel. The ratio of reduction between the armature-shaft pinion and the wheel gear is 3.5 to 1.

Each motor weighs about 3000 pounds. With this equipment and the regular train a speed of about 15 miles an hour may be obtained. Each motor is suspended on the truck from two trunnions in the upper field set in two bars, the outer ends of the bar resting on elliptical springs. The axle is thus relieved of nearly all the weight of the motor.

At the base of each motor, facing the ends of the car, is a small roller which depresses the cable and allows it to pass the motor without injury, while a long iron bar runs beneath the truck and depresses the tilting sheaves, preventing them from striking the motor.

The operation of the motors is controlled by series-parallel controllers of the L 4 type, which have given such general satisfaction on the Chicago roads.

The indicating dial of the controller is placed at the top of the platform rail and is lettered "series," "multiple" and "off," showing exactly the position of the controller itself. The reversing handle is a jointed handle which can be placed on or taken off the reversing switch spindle only when the controller handle points to the "off" position, showing that there is no current in the motors at that moment. The controller itself has no effect until the long arm of this jointed handle is dropped into the "forward" or "reversing" notches in the reversing handle plate. There are two controllers, each operated from its own platform and either controller will operate the four motors or any two of them, as may be desired.

The resistances, as well as the magnetic cut-outs, are also placed beneath the car floor. Beneath each hood of the car is an automatic circuit-breaker, placed within easy reach of the motorman. The operation of this device is instantaneous, and is an effectual safeguard against any accident to the motor. These circuit-breakers take the place of the main circuit hood switches, but are wired in multiple with each other, instead of in series. To guard against any possibility of one being closed while the motorman is at the other end of the car, and desires to open his main circuit, only one handle is provided. The handle cannot be taken off without opening the circuit-breaker, and when removed the circuit is locked open. As the motorman must take the controller and circuit-breaker handles with him when changing ends all danger of complication is avoided.

The car is equipped with 12 electric heaters, manufactured by the Consolidated Car Heating Company, of Albany, N. Y. This system of heating has been extensively adoped on the surface cars in the City of Brooklyn and the consequent abolition of the objectionable stove has caused a general feeling of relief. The heaters consist of a slab of porcelain in front of which is a cylinder of porcelain wound with galvanized iron wire. These heaters have a maximum capacity of 40 square feet of radiating surface at 400 degrees F. Five different temperatures to suit the weather can be obtained by means of a controlling switch.

The collector (Fig. 3) which will take the current from the overhead wire is a diamond-shaped frame of metal set longitudinally upon the roof of the car and carrying at right angles a bar, in the centre of which is a roller. The arms are wide enough to preclude any possibility of missing contact. The diamond frame is depressable and expansible on the principle of the pantograph, allowing a play up and down to conform to the varying heights of the overhead wire. With this collector the trouble of reversing is entirely done away with.

The power to run the car will be taken from the overhead wire already in position supplying current to the electric lights in the cars. The extra current, however, will be supplied from the Fulton Street feeder of the Kent Avenue Station of the Brooklyn City Railway, the return wire being connected to the rails of the surface road.

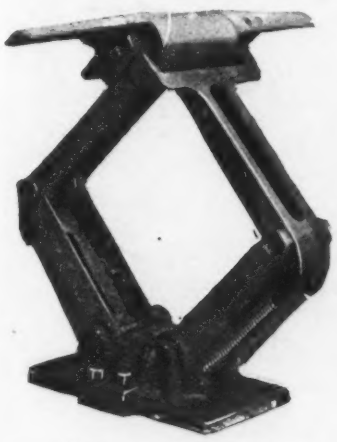
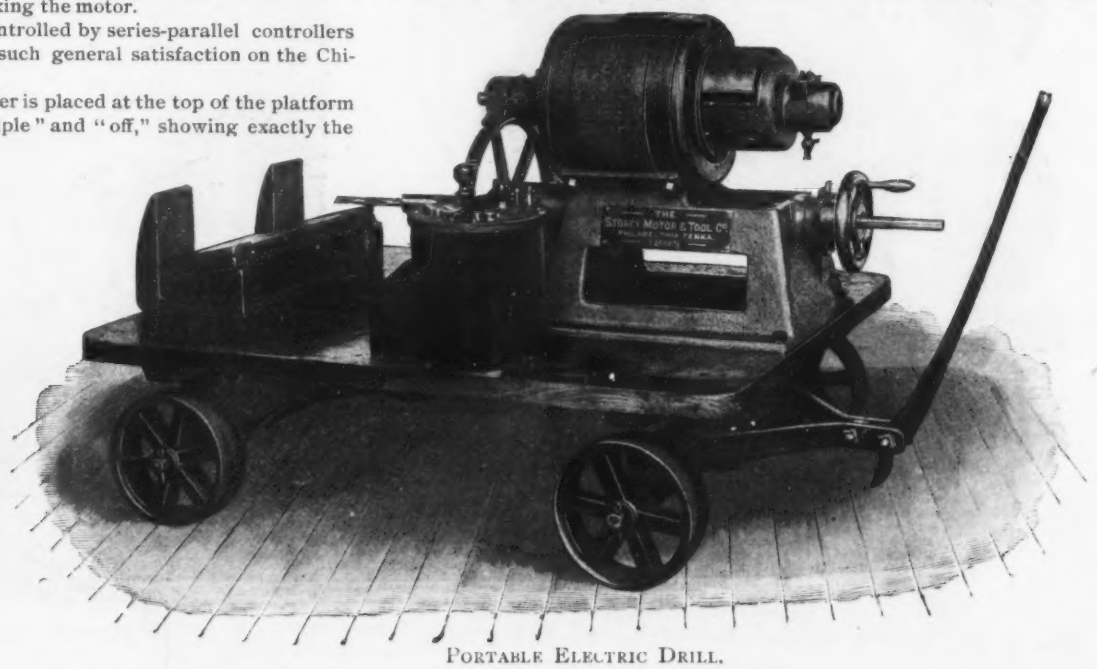


FIG. 3.—COLLECTOR.

Portable Electric Drills.

The portable electric drill we illustrate, which has been placed on the market by the Storey Motor & Tool Company, of Philadelphia, is adapted for drilling pig iron and copper for test work, for drilling rails and various other kinds of work. Owing to the type of the motor, which is entirely enclosed, it is suitable not only for indoor work but can also be used for outside purposes without requiring any specially arranged covering for its protection. The outfit complete consists of a motor and drill combined together with a regulating rheostat for obtaining any desired speed, and a drum with 100 feet of flexible cord, all mounted on a truck, with or without a rack for holding material to be drilled as desired. These



PORTABLE ELECTRIC DRILL.

machines drill in sizes up to 1⅛ inches in steel and 2 inches in cast iron, and are furnished with both automatic and hand feeds.

The rapid adoption of electricity in machine shops and factories makes a tool of this kind extremely useful as it can be moved at will wherever it is needed. These drills can also be placed on a table or in any stationary position, and will cover a large range of work of different classes. As an illustration, two of these drills have been mounted on bed-plates, one at each end of a large callender roll to drill two holes in flanges at the same time and tap them in the same operation, before the roll is moved.

Another adaptation consists in fitting it with a telescoping shaft for use in yards for drilling holes in the construction of switches and crossings for street car and railway work.

New Search Lights.

Electric search lights are to-day of two distinct types—the lens mirror projector, in which the light from an arc lamp is both refracted and reflected by a large lens having its posterior surface silvered, and the

FIG. 1.—PLAIN PROJECTOR.

common head light, with its simple concave reflector. The enormous cost of the lens mirror projectors, which are used in naval services, prevented their adoption in the commercial marine, so that for years all in that service have been of the latter type, with cheap, silver-plated, sheet-copper reflectors.

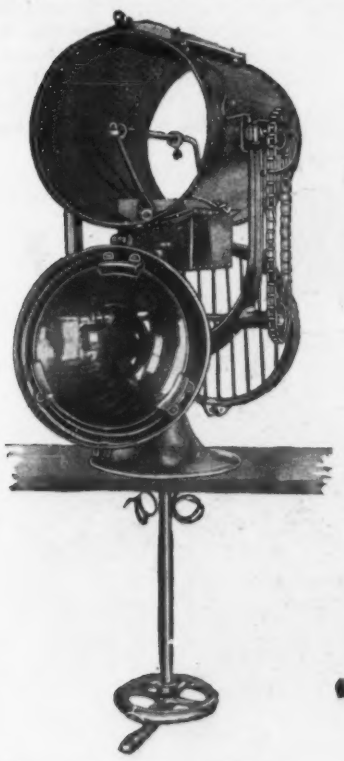


FIG. 2.—PILOT HOUSE PROJECTOR.

FIG. 3.—PROJECTOR LENS.

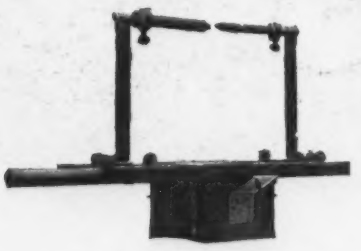


FIG. 4.—PROJECTOR LAMP.

Such lights have been found quite satisfactory on inland waters, but they so scatter the light, and are of such limited range, that the few ocean steamers that adopted them have found them of little use except when making landings. With copper reflectors the silver plating soon burns or rusts away, and the light becomes unsatisfactory. An attempt was made to lessen this trouble by forming an enlargement or cup in the reflector near the arc to reduce the heating, but this only partly remedied the difficulty, and made it necessary to use a set of lenses to correct the derangement due to the cup, which lenses obstructed the light and were soon broken.

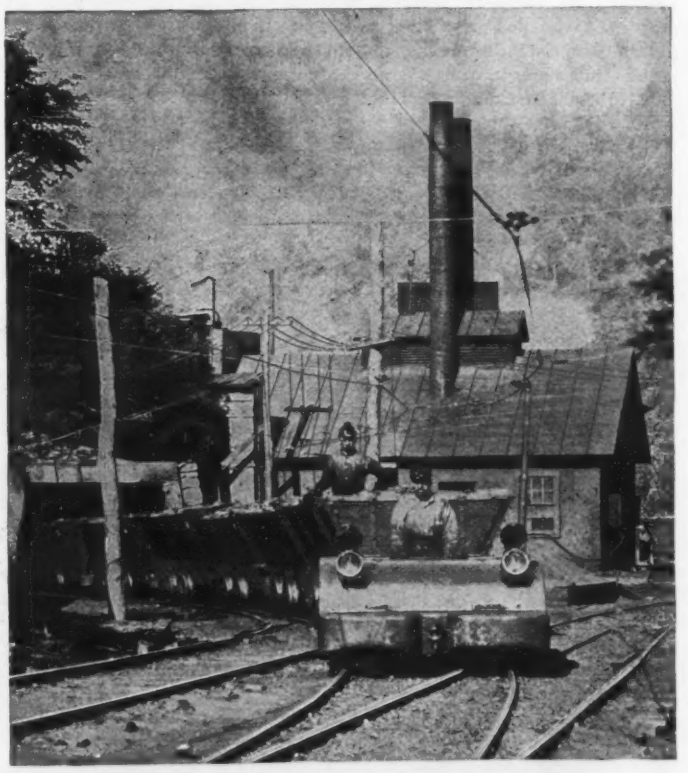
Although formerly manufacturing search lights of the latter class, Mr. S. W. Rushmore, of Jersey City, N. J., has long realized that the commercial search light, to be perfect, must be of the silvered lens type, and this class he is now to manufacture by a new process at a cost, it is claimed, even less than the old reflector apparatus. Owing to the superior efficiency of lens projectors and the fact that they throw a perfectly parallel beam, such projectors, it is claimed, will give over 40 times the light of the old type, the intensity being estimated at 1,000,000 candles per ampere in the arc.

Fig. 1 shows a plain projector rated at an intensity of 80,000,000 candle-power, and designed for use on the larger ocean and lake steamers. Fig. 2 is a new pilot-house light which has a new method devised by Mr. Rushmore for controlling the light from within the pilot-house, the device being a great improvement over that previously used, and much simpler and cheaper. The illustration shows the projector with the front door open and the rear cover let down, showing the method of mounting the lens and also indicating how readily the apparatus may be cleaned and supplied with new carbons. Fig. 3 is the new Rushmore "aplanatic" mirror, which forms the chief part of the apparatus. This lens is of a new design, which not only corrects the scattering due to the area of the carbons, but has the property that by slightly changing its position, the light may be spread out as wide as desired without the additional and expensive diverging lenses used in the navy. Fig. 4 shows the new Rushmore concentric arc lamp used in the projectors. These projectors are made by the Rushmore Dynamo Works, Jersey City, in connection with which a complete lens-making plant has been established.

Electric Mine Haulage.

The accompanying illustration of an electric locomotive hauling a loaded trip to the tipple very plainly shows the superiority of the electric system of mine haulage over either rope or any other. The photograph from which this cut was made was taken at the mines of the Pulaski Iron Company, at Eckman, W. Va., which was recently equipped by the Jeffrey Manufacturing Company, of Columbus, O., with a complete plant of coal cutting, drilling and electric haulage machinery.

This locomotive does the entire hauling and gathering of the loaded cars along the butt and main entries, hauling the coal to the top of an incline. The tracks at the mouth of the mine are so arranged that the locomotive makes a flying switch, cutting loose from the loaded trip, allowing the latter to continue to the top of the incline, while the locomotive runs down to the empty cars, takes them in the mine and distributes them to the various points, where they are taken by the miners into the rooms.



ELECTRIC MINE LOCOMOTIVE.

Quite a large number of these locomotives have entered into use during the past year, some 14 or 15 different plants in all having been equipped. They are built in all sizes, from 15 horse-power up to 175, and for all gauges from 18 inches up to the standard 4 feet 8½-inch gauge.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 8, 1896.

AMERICAN BELL gained strength steadily during the week, and the stock advanced a point a day, closing at 198 on Monday and 203 to-day. The company's instrument report for the month ended Jan. 20, shows a net output of 10,052 against 1686 for the same month a year ago. This showing, together with the stories being circulated by the bulls alleging the Bell Company's intention to compete with the Western Union at the expiration of the contract between the companies, has had a decided strengthening effect upon the stock.

GENERAL ELECTRIC closed lower this week than last, and has not displayed any great amount of strength, notwithstanding the statement made to the effect that the company closed its year with $800,000 cash on hand, and has neither borrowed money nor endorsed a note during the year.

BOSTON EDISON ILLUMINATING COMPANY reports for 1895 gross earnings of $709,002, as against $628,406 for 1894, and net earnings for 1895 of $252,701, against $317,164 for the previous year.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	93	96
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	32½	34¾
Electric Storage, pref	100	33	34
General Electric	100	29½	30
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	30	31
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202	203
American District Telegraph	100	33	40
American Telegraph & Cable	100	93	96
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	61	61½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	..	89
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	85⅝	85¾

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17	17¼
Binghamton RR. com.	100	100	..
Brooklyn Traction	100	9½	11
" " pref	100	50	53
Buffalo St. Ry	100	71	74
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	45	48
Hestonville	100	48	..
Long Island Traction, all pd	100	20¾	21
New Orleans Traction	100	16	18
" " pref	100	64	67
North Shore Traction	100	29	33
" " pref	100	78	82
Rochester St. Ry	..	27	35
Steinway, Ry	..	49	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	10¾	11⅛
West End, Boston	100	68	68½
" " pref	100	93	..
Worcester Traction	100	13	15
" " pref	100	84	..

BONDS.

Buffalo St. Ry. 1st con. 5s	100	104	107
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.

THE TRACTIONS.—The attention of the stockholders of the various Brooklyn roads and of the Buffalo Railway Company has been directed this week toward Albany, where Assemblyman Husted has introduced a bill which affects their interests to a large extent. By the terms of this bill any city street railway company (outside of New York City) desiring to extend its mileage must apply to the State Railway Commissioners for permission to do so. The Buffalo Traction Company, which failed to obtain from the commissioners "a certificate of necessity," is now endeavoring to enter the city through the extension of a suburban line within the city limits. If Mr. Husted's bill is passed, the matter will have to come before the same commissioners, who have only just denied their application, and in all probability they would not gain their end. The various Brooklyn roads, too, which have been fighting for some weeks past for permission to extend their lines, would be compelled to submit to the decision of the commissioners.

BROOKLYN CITY RAILWAY and Brooklyn Traction securities have advanced considerably, the former, it is said, on the publication of the report for the quarter ending on Dec. 31, and the latter on the expected announcement of the Nassau-Brooklyn lease. While the gross earnings of the former roads have decreased $87,324 for this period, which is doubtless due to the reduced speed of the cars and the effects of the strike, yet under the present management the operating expenses for the same period have been reduced $68,560 without any detriment to the road. The enlarged system of transfers has temporarily had a depressing effect on the gross earnings, but the increased traffic on the road is expected to more than compensate for this in the near future. The Brooklyn Traction-Nassau lease is said to extend for 999 years.

BUFFALO RAILWAY stock strengthened somewhat during the latter part of the week, presumably upon the belief that the Husted bill will become law and the floating supply of stock has been pretty well absorbed. It is generally believed that any further attempts on the part of the Traction Company will end in failure.

COLUMBUS STREET RAILWAY stock has strengthened considerably and last week's floating stock has been readily absorbed. The contest between this company and the Columbus Central regarding the right of the latter company to run its cars over a portion of the tracks of the former promises to be long drawn out.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 10, 1896.

THE C. J. FIELD COMPANY, consulting engineers for electric traction, power transmission and generating stations, has removed to the Taylor Building, 39 Cortlandt Street, New York.

VAN LOAN BROTHERS, 317 East Ninety-fourth Street, New York, have recently opened an establishment for the repairing and rewinding of all types of armatures, and are paying special attention to the G. E.-800 armature.

EDWARDS & CO.'S electrical works, in 144th Street, near the cut of the New York Central Railway, were almost entirely destroyed by fire last week. All the floors were burned through and the machinery and stock, which were valued at $25,000, were destroyed. There is an insurance of $15,000.

ALBERT STETSON has taken the American agency for the Neuhausen Calcic Carbide Works, with offices at 243 Broadway, New York. He is prepared to supply calcic carbide in original packages from Neuhausen, and at a price which, owing to the exceptionally cheap manufacturing facilities possessed by the Swiss company, cannot, Mr. Stetson believes, be equaled in this country.

WENDELL & MACDUFFIE, 26 Cortlandt Street, New York, have taken the Eastern agency for the Warren alternator, made by the Warren Electric Company, of Chicago, Ill. This machine, recently described in our columns, is of the inductor type, having no moving wires. The armature being stationary, its connections can be so changed or combined as to give a number of different voltages, and even two or more voltages on separate circuits may be obtained from it at the same time.

MR. F. H. BALL has sold his interest and retired from active participation in the management of the Ball & Wood Company of Elizabeth. Mr. Ball has been one of the officers of this company for a number of years, and will take up actively the business of consulting engineer and mechanical expert, in which capacity he will still be connected with the company, and his son, Mr. Bert C. Ball, also remains at the head of the draughting department. The business of the Ball & Wood Company has been excellent during the past year, and has extended largely through the West since its Chicago office was opened a year ago. At present its shops are very busy executing the contract for a number of large engines for the Edison Electric Illuminating Company of Paterson, and also orders for the New York & Brooklyn Bridge; Johnston Building, New York; Ellicott Square Building, Buffalo; St. Charles Hotel, New Orleans and others.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 8, 1896.

AN ELECTRICAL TRADES ASSOCIATION for Boston is still being agitated, and important meetings have been held recently.

PRESIDENT H. C. HAWKS of the Anchor Electric Company, Boston, is away on a business trip West, conferring with agencies and looking after business generally.

PLUMMER & HAM, WORCESTER, MASS.—A typographical error in these notes last week made the last-named gentleman read Haur; otherwise the note was all right. This firm starts business magnificently housed at 619 Main Street, well stocked with electrical supplies of all kinds, and prepared for electrical engineering and construction work of first-class order.

THE ELECTRIC POTENTIAL CLUB, Boston, will shortly announce another dinner, to occur this month. President Frank Ridlon believes that the occasion will beat the second in interest and attendance. "Legislation, touching the electrical interests of Massachusetts" will be handled ably and "without gloves." The special committee of the State legislature will be invited, and have signified their intention to be present, as well as other prominent city and State officials.

THE PETTINGELL-ANDREWS COMPANY, Boston, has just completed some important changes in its spacious salesroom. The massive compartment structure for the smaller electrical specialties, which occupied the centre of the main floor, has been transferred to the retail department to the right of the entrance, thus creating valuable floor space for stock in bulk, rendering also more conspicuous and attractive its handsome display of electrical apparatus, arc lamps, etc., and improving very materially the general appearance of its salesroom and executive offices. General Manager Price and Treasurer Andrews are constantly evidencing rare abilities in the management of the large and growing business of this company.

THE AMERICAN BOLT COMPANY, Lowell, Mass., has experienced a change recently in the resignation of Mr. M. F. Brennan as treasurer and manager, the duties of which position will hereafter be discharged by Col. Percy Parker, president of the company. Col. Parker is in every way thoroughly familiar with the business of the company, and is to be congratulated in having the able assistance of Mr. W. M. Shirwell, long connected with the company. Col. Parker is a most prominent business man in Lowell, is a member of Gov. Greenhalge's staff, is quite well known electrically, being treasurer of the Lowell & Suburban Street Railway Company, and identified with the Electric Light & Storage Battery Company, which now confines itself to general electrical supplies, and electrical engineering and construction work.

THE COLUMBIA ELECTRIC COMPANY, Worcester, Mass., has a most important and interesting exhibit in connection with the Food and Health Exposition now open in that city. The exhibit of this company is located in a tastefully decorated booth, and is under the supervision of its enterprising manager, Mr. John P. Coghlin. It is a display of every kind of electrical apparatus, motors, batteries, bells, telephones, cigar-lighters, lamps, etc., etc., both in operation and on exhibition. The booths of the other exhibitors are lighted by incandescent lamps furnished by the Columbia Electric Company, and it provides a telephone service, with "National" telephones, for which it is local representative. It also exhibits ornamental Manhattan arc lamps (for which it is sole agent for this district) in operation. Electrical cooking apparatus, moreover, forms an interesting feature of this exhibit. There is also symmetrically arranged a display of batteries, wire, cleats, cut-outs, and all kinds of electrical supplies kept in stock by the Columbia Company, which makes a specialty of supplying local stations and private consumers throughout Central Massachusetts with every variety of this class of material.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Feb. 7, 1896.

THAD S. LANE, manager of the Chicago office of the Orient Electric Company, has his headquarters at 1628 Monadnock Building, and carries a complete line of the "New Orient" lamps in stock. Mr. Lane is a thorough lamp man and is doing a good business in and around Chicago.

THE ELECTRIC APPLIANCE COMPANY has just prepared a special catalogue of the "Paiste" specialties, listing a complete line of Xntric switches, Paiste sockets, cut-outs, etc., together with a special net price list on same. This makes quite a valuable list for reference, as considerable of the material has not been previously catalogued.

CANADIAN NOTES.

PORT ARTHUR, ONT.—The by-law to provide $15,000 for electric light has been defeated.

ARNPRIOR, ONT.—Mr. Bolfield, of Eganville, is seeking a franchise for electric lighting.

MORRISBURG, ONT.—The village Council is considering the question of putting in an electric light plant.

HAMILTON, ONT.—A company is being formed to open a Summer resort at Chedike Park, and to build a double track railway.

VANCOUVER, B. C.—The power-house for the Western Light, Heat & Power Company will probably be built on False Creek.

BROCKVILLE, ONT.—Work on the electric railway, to be built by the Electric Street Railway Company, will be commenced before the Fall.

QUEBEC, QUE.—Mr. Beemer, the promoter of the electric railway scheme, is said to have made arrangements for the immediate construction of the road.

TORONTO, ONT.—The Toronto Electric Light Company has invited tenders for pile driving and excavating necessary for the foundation of its new power-house

HULL, QUE.—T. Viau, of the Hull Electric Company, which proposes to construct an electric railway between Hull and Aymer, writes that he has a first-class water-power, and is forming a joint stock company to build the line which will be seven miles in length. In the lighting service 3000 incandescent lights and 100 arc lamps will be used. Probable cost of the work, $65,000.

WINDSOR MILLS, QUE.—The works of the Canada Paper Company are shortly to be operated by electricity Power from the St. Francis River, one mile distant, will be transmitted to the mills. The factory will also be lighted by electricity, and an electric railway will be constructed from the power-house to the mills. The total amount of power to be transmitted is about 1000 hp. The work is in the hands of Mr. Geo. White-Fraser, electrical engineer, Toronto.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Jan. 29, 1896.

THE WATERLOO & CITY RAILWAY.—This tunnel electric railway, which is to connect the Waterloo terminus with the centre of the city, is now three parts finished, so far as the tunnel lining and driving is concerned.

ARC LIGHTING IN THE WEST END.—After many years the local authorities concerned have decided to redeem the West End streets of London from being the worst lit streets in any civilized metropolis, and have entered into a contract with the St. James & Pall Mall Company to supply current to sixty arc lamps at the rate of £30 per lamp per annum.

ELECTRIC SUPPLY COMPANIES' DIVIDENDS.—The St. James & Pall Mall Electric Lighting Company, which supplies the best part of the West End of London, and the Westminster Electric Supply Corporation, which has a somewhat larger but scarcely so good a district, have respectively declared dividends of 7¼ per cent. and 7 per cent. as against 6½ per cent. and 5 per cent. last year.

THE BERRENBERG MECHANICAL VACUUM PUMP.—After many months of continuous experiments and financial negotiations on this side of the water, Mr. Berrenberg has succeeded in forming a company to exploit his well-known mechanical vacuum pump. He has obtained an exceedingly lucid and exceedingly satisfactory report from Prof. W. E. Ayrton, F. R. S., and a concern called the "Langhans-Berrenberg-Chaplin Patents, Ltd.," is now bringing before the public the Langhans filament patents and the Berrenberg pump patents.

MUNICIPAL ELECTRIC TRACTION.—The Town Council of Newcastle, have at present a bill before Parliament in connection with the purchase and working of the tramway network of that city. At a recent meeting of the Council it was decided by 31 votes to 16 to insert additional clauses in the bill enabling the entire system of the city to be worked by electricity. This was brought about by the report of a committee, which had been visiting Bristol, the members of which, for the most part, came back to Newcastle completely converted in favor of the overhead trolley system. At Plymouth, a report by Dr. J. A. Fleming, coupled with a visit to Bristol, has had a similar effect on the members of the Town Council, and they recommend that at Plymouth there should be an electric lighting and power station combined with a dust-destructor. The report contained a paragraph to the effect "that the committee consider that the overhead system of electric traction, if care and attention be paid to design and form, and if the columns carrying the conductors are used as lamp-posts for arc lamps, causes no disfigurement to the thoroughfares, and that the system is safe, convenient, clean and economical."

THE HOPKINSON THREE-WIRE PATENT.—Notice has been given that it is the intention of John Hopkinson and the English Westinghouse Company to petition the Privy Council for a prolongation of patent No. 3576 of 1882, popularly known as the "three-wire patent." This patent in the ordinary course would expire on July 27 next. Some three years ago an action was brought by the owners of the patent against the St. James & Pall Mall Electric Lighting Company, with the result that the patent was upheld, and all concerns in this country working three-wire systems have since then had to pay royalties to the Westinghouse Company, It is therefore highly probable that strenuous opposition will be offered to the prolongation of the patent. The patent, previous to the trial of the action referred to, was amended, and four claims cut out; the second of the two remaining claims, however, clearly sets forth the three-wire principle. This claim runs as follows: "In a system of electrical distribution or supply, the employment of three or more conductors in combination with two or more dynamo machines in series where the middle conductor be continuous or be replaced by an earth-return."

AN ADVANTAGEOUS CONTRACT FOR A MUNICIPAL CENTRAL STATION.—The Shoreditch Vestry, which has an electric supply station in the course of construction, has just concluded a contract with the London, Walthamstow & Epping Forest Railway Company which seems likely to prove extremely advantageous both to itself and to the company. This company is about to build a tunnel railway running through the centre of London to Epping Forest, and it has agreed to take from the Vestry a minimum of 300,000 kilowatt-hours per annum, at the rate of 1½d. per unit; its maximum demand, it is expected, will be about 420,000 kilowatt-hours. The railway company will require to be supplied with current during the daytime, and undertakes to provide the necessary accumulators and subsidiary apparatus to supply itself with light for its stations and tunnels during the hours of heavy load, so that no extra plant will be required by the Vestry in order to supply this large output. The Shoreditch Vestry, as I have mentioned before, proposes to largely fire its boilers by means of the heat arising from its refuse destructors, and it proposes also to store this heat, when not required, on the Druitt-Halpin thermal storage system. It is therefore expected that the cost of fuel per kilowatt-hour will, in the case of the Vestry, prove an extremely low one. Up to the present, ½d. per unit is about as low a figure for fuel as has been attained, but under the Shoreditch scheme, it is possible that this will be very materially reduced. It is therefore altogether probable that at least 1d. of this 1½d. per unit will be clear profit to the Vestry, so that about £15,000 net profit may be expected to be annually derived from this source. It is fervently to be hoped that the many tunnel railways which have been awaiting the favor of the capitalist, will, when they are realized, find it advantageous to obtain the current necessary for the lighting of their tunnels and stations in a manner similar to that which has been found advantageous in the case of the London, Walthamstow & Epping Forest Railway, since there is many a metropolitan electric supply company which would gladly welcome steady and remunerative day load as that which has been obtained by the Shoreditch Vestry.

HOUSE WIRING.—There was a lengthy discussion on Thursday evening last at the Institution of Electrical Engineers on the papers on House Wiring recently read by Mr. Sam Mavor and Mr. Fred Bathurst; the paper of the former being a well-sustained eulogy of concentric wiring (with the outer earthed) and the paper of the latter being an equally sustained pæon in favor of the interior conduit system. Taking the discussion as a whole, it cannot be said that the meeting was carried away with enthusiasm by the merits of either of the systems advocated. Indeed, one speaker cynically pointed out that inasmuch as Mr. Sam Mavor claimed every virtue possible and impossible for the concentric system, and Mr. Fred Bathurst did the same for the interior conduit system, it was obvious to the impartially minded man that neither system would do for every job. On the other hand, several speakers spoke from experience strongly in favor of concentric wiring, both as regards adaptability to various types of buildings, cheapness, safety and ease of running up, etc., while not a single speaker spoke in favor of the interior conduit system as advocated by Mr. Bathurst; the one or two advocates of pipe wiring preferring good wrought-iron pipe as a mechanical protection for the insulated wires. Wood casing still found several adherents, or rather several gentlemen who were bold enough to say that it had done good service in days gone by, and was not destined to be snuffed out entirely for some time to come. Incidentally several speakers referred to the much-debated question of the advisability of introducing higher pressures than 10 volts volts in to consumers' houses, and these remarks exemplified in a striking manner the divided state of things, which now reigns on this point in this country. Mr. Geipel, of the Brush Electrical Engineering Company, urged that until we had a good eight-cp 100-volt lamp, it was folly to introduce 200-volt lamps, and from the consumers' point of view a pressure of 50 volts would be better even than 100 volts, since it would place cheap, long-lived and efficient eight-cp lamps at his command. Another gentleman, however, said that he had for some time been using 200-volt lamps of all candle-powers, and had absolutely no fault whatever to find with them. Incidentally also, several speakers referred to the raising of the premiums for central-station insurance, which is threatened by the fire insurance companies, and Sir David Salomon's suggestion that central-station industry would do well to become self-insuring received a warm welcome. The discussion was adjourned until Feb. 13.

General News.

NEW INCORPORATIONS.

THE MANISTEE ELECTRIC SUPPLY COMPANY, of Manistee, Mich., has been incorporated with a capital of $50,000. One of the specialties of the company will be long-distance telephones. Fifty men will be employed.

THE FREDERICKSBURG ELECTRIC LIGHT COMPANY, Fredericksburg, Tex., has been incorporated by C. H. Nimitz, Alf. Van Der Stucken and Ad. Gold, for the purpose of furnishing electric light. Capital stock, $7000.

THE LADONIA MODEL GIN & ELECTRIC LIGHT COMPANY, Ladonia, Tex, has been formed by T. V. Richards, S. C. Rilyea and D. E. Waggoner, for the purpose of ginning seed cotton and baling the same and for supplying electric light. Capital stock, $16,000.

THE KALAMAZOO RAILWAY VELOCIPEDE & CAR COMPANY, Kalamazoo, Mich., has been incorporated by Heber C. Reed, Horace C. Haines, Elbert S. Roos, Kalamazoo, for the purpose of manufacturing railway velocipedes, electrical supplies, etc. Capital stock, $45,000.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY, Milwaukee, Wis., capital stock, $8,000,000, has been formed by W. N. Cromwell, A. Marcus, C. W. Wetmore, New York City; C. F. Pfister, F. C. Bigelow and B. K. Miller, Milwaukee, Wis., for the purpose of constructing city railways and furnishing electric light.

THE BOND POWER COMPANY, San Francisco, Cal., capital stock, $500,000, has been incorporated for the purpose of borrowing and loaning money on all classes of security, buying and selling electric power, and doing a general banking and commission business. Those interested are H. H. Snow, Oakland; C. S. Haskell, J. A. Thompson, John W. Eisenhuth, and J. K. Willats, San Francisco, Cal.

TELEGRAPH AND TELEPHONE.

DYSART, IA.—There is talk of the Commercial Telephone Company extending its line to this place.

TECUMSEH, NEB.—The business men of Tecumseh are agitating the formation of a new telephone company.

PRAIRIE DEPOT, O.—Prairie Depot is to have telephone connections with Toledo, Fostoria, Gibsonburg and Bradner.

COLUMBIA CITY, IND.—A company has been organized at Columbia City, to put in a first-class telephone exchange. A. A. Adams is president.

PARSONS, KAN.—An ordinance has been passed by the Council that an electric fire alarm be provided for at the expense of the telephone company.

SOUTHAMPTON, L. I., N. Y.—A telephone line via North Sea to Rose's Grove and Noyac is being arranged for and will probably be constructed before Summer.

LA GRANGE, IND.—A paper is being circulated for the purpose of raising money to put up a telephone line from Lima to Tongo, by the way of Ontario, and to La Grange.

WARREN, O.—A company is being formed for the purpose of building and operating a telephone line between Warren, Cortland, Burg Hill, Kinsman, Orangeville and Greenville, Pa.

ROSENDALE, N. Y.—The Citizens' Standard Telephone Company will probably complete the extension of its line from Rosendale to High Falls, and be in communication with the latter place.

ESCANABA, MICH.—The Common Council has ordered the Bell Telephone Company's poles off the street, declaring that as the company has no subscribers, the poles are a public nuisance.

HICKSVILLE, O.—Judge Snook, W. H. Phipps, and J. P. Gasser are said to be organizing a company to build a telephone line connecting Van Wert, Paulding, Payne, Antwerp, Hicksville and other towns.

LIVINGSTON MANOR, N. Y.—The Beaverkill Telephone Company has voted to extend its line to Livingston Manor, where it will connect with the Sullivan County system. It was also voted to look over the route with a view to extending the line of Margaretville to a connection with the West Shore system.

KINGWOOD, W. VA.—The Kingwood & Dunkard Bottom Telephone Company has been organized to construct a telephone line from Kingwood to I. Parsons Martin's residence on Dunkard Bottom, about 3½ miles from Kingwood. Col. A. F. Martin is president, I. P. Martin, secretary and treasurer, Nathan Wilson, superintendent. The line will be constructed at once.

ELECTRIC LIGHT AND POWER.

AMES, IA.—An electric lighting plant is to be installed here.

WINCHESTER, TENN.—J. L. Girton proposes to put in an electric light plant.

WAPELLO, IOWA.—The Wapello Electric Light & Power Company has been organized.

FLORA, IND.—The citizens are discussing the question of putting in an electric light plant.

ARGUS, IND.—The agitation in favor of an electric lighting plant will, it is said, soon bear fruit.

ALTA. IA.—The City Council will advertise for bids for the construction of an electric light plant,

MURFREESBORO, TENN.—The council has decided to have the streets lighted with electricity.

PRATTVILLE, ALA.—The people of Prattville are now talking about electric lights and water-works.

WAYNE, PA.—Fire destroyed the plant of the Wayne Electric Light Company, causing a loss of about $40,000.

BOWLING GREEN, O.—A contract for a new electric light and power station has been awarded to A. Graham.

BELLEVUE, KY.—The Council has adopted a resolution to advertise for bids for lighting the streets of South Bellevue with electricity.

OAKLAND, CAL.—Lightning on Jan. 26 struck and completely destroyed the electric machinery of the Haywards Electric Light Company.

LOCKPORT, N. Y.—The matter of issuing $40,000 worth of bonds for the purpose of establishing a municipal light plant is before the Councils.

QUINCY, FLA.—The Quincy Electric Light, Heat & Power Company proposes to put in a lighting plant to be operated by water-power, four and a half miles from the city.

GREENWICH, O.—A special election held to issue bonds for the purpose of building electric lights and water-works was carried in favor of issuing bonds by a large majority.

HOLLIDAYSBURG, PA.—Chairman John H. Law, of the Council Committee on Light, has presented a report recommending that the Borough establish its own electric light plant.

MOHAWK, N. Y.—There will be a special election for the purpose of giving tax-payers an opportunity to vote on the proposition that the village erect and operate an electric light plant.

HENDERSON, KY.—The City Council has accepted the plans and specifications submitted by Pierce & Richardson, of Chicago, for the erection of a municipal electric lighting plant.

COLUMBUS, O.—Hon. Charles Q. Davis is preparing and will soon introduce into the House of Representatives a bill to authorize the city to issue bonds for $100,000 for a municipal lighting plant.

ST. LOUIS, MO.—An ordinance is now before the House of Delegates granting a franchise to the St. Louis Electric Company, a concern not yet incorporated, the life of the contract to be 50 years.

SAN FRANCISCO, CAL.—Laist & Schwerdt, Spreckels Building, have prepared plans for a $150,000 theatre building to be erected by a stock company. The theatre will be provided with an electric light plant located in an annex.

APPLETON, WIS.—The Edison Electric Company, including the electric street railway and electric lighting plant, has been sold under foreclosure proceedings to Mr. A. L. Smith of the Appleton Electric Light & Power Company for $132,500.

LINCOLN, NEB.—Sealed proposals will be received at the office of the Commissioner of Public Lands and Buildings, Feb. 17, for the installation of a complete incandescent and arc electric light plant, to be installed at the Penitentiary of the State of Nebraska.

HENDERSON, KY.—The City Council has accepted the plans and specifications submitted to it by Pierce & Richardson of Chicago, for the erection of an electric light plant for the city. There will be 175 arc lights, and the contract for building the plant will be let within a few days.

CARROLLTON, ILL.—The city will receive bids for furnishing the city with 35 arc lights, 2000-cp, Philadelphia schedule. Bidders will also make a proposition to furnish sufficient power from the electric light plant to run the city water-works, with privilege of renewal at the option of the Council.

NEW CASTLE, COL.—Sealed proposals will be received by the trustees of the town, Feb. 24, for the furnishing of an electric light and power plant. The plant is to furnish light for 600 incandescent lamps and 50 arc lamps, with steam engine and boiler of sufficient capacity to operate a plant one third larger than named above. F. D. Pierce is recorder.

The Electric Railway.

QUINCY, ILL.—J. C. Hubinger, of Keokuk, proposes to build an electric railway between Quincy and Keokuk.

PULTENEY, N. Y.—Pulteney citizens want the electric railway from Bath to Hammondsport extended into their town.

KENOSHA, WIS.—The Bell City Street Railway Company has applied for a franchise to construct and operate an electric road.

CORNWALL, ONT.—The contract for the construction of the electric railway has been signed by Messrs. Hooper & Starr, of Montreal.

RIDGEWAY, ONT.—The Crystal Beach Improvement Company proposes to construct two miles of electric railway from Crystal Beach to Ridgeway.

BROOKLINE, MASS.—The West End Street Railway Company is opposing the construction of a line by a rival company on the streets of Brookline.

PENSACOLA, FLA.—The security-holders of the Pensacola Terminal Railway Company are considering the project of equipping the road with electricity.

PORTLAND, ME.—It is understood that the tracks of the electric road, on Spring and Vaughan Streets, are not heavy enough and will be relaid in the Spring.

WEST FAIRFIELD, PA.—There is some talk of a new electric road running from West Fairfield to New Florence. The newly organized board met and talked the matter over.

CLYDE, N. Y.—The project of an electric railway extending through Clyde to Sodus is again being agitated. The route proposed is from Waterloo or Seneca Falls via Clyde to Sodus.

LANARK, ONT.—The rate-payers will vote on a by-law granting the sum of $10,000 for an electric railway from Perth to Lanark. The members of the proposed company are J. B. Reilly, Alex. Wender and others.

RICHMOND, VA.—The Fairmount Traction Company has asked a franchise to construct an electric road in Richmond and Henrico Counties. William T. Hechler and William J. Westwood are among those interested.

OSWEGO, N. Y.—The consent of property owners for the Erie Street extension of the street railway have been filed with the City Clerk, and at a meeting of the Common Council a franchise will be granted the company.

KENSINGTON, PA.—Ground has been purchased, adjacent to Kensington, on which a power-house will be erected for a proposed system of electric railways to connect with Kensington, Arnold, Parnassus and extend to Pittsburg.

NEW HAVEN, CONN.—The New Haven Street Railway Company is preparing for an extension of the Whitney Avenue line to Centerville. The road will be 2½ miles in length, and will probably be completed before the Summer is over.

PITTSBURG, PA.—The Second Avenue Traction Company is perfecting arrangements to connect McKeesport with Pittsburg, via Brinton station, thus completing a belt line beginning and ending at Fourth Avenue and Market Street, Pittsburg.

ALBANY, N. Y.—The State Railway Commissioners have approved an application of the Binghamton, Lestershire & Union Street Railway Company for an increase of its capital stock from $100,000 to $250,000. The company is to put in new equipment.

CATSKILL, N. Y.—Permission to lay tracks and operate a road through the village of Catskill, was granted at a recent meeting of the village directors. Part of the road is to be double-tracked, and the lines to be operated on the principal streets. The road must be in operation by July 1.

PLATTSBURG, N. Y.—The Plattsburg village trustees granted a franchise to the Plattsburg Traction Company giving the company the right to build, maintain and operate an electric street railway in the village. The company expects to have the road in operation between Plattsburg and Bluff Point by July.

WATERTOWN, N. Y.—It is announced that Austin Corbin, president of the Elmira, Cortland & Northern Railway Company, is anxious to secure control of the Watertown & Brownville Street Railway, and that he intends to make the electric road here a part of the proposed extension of the Elmira, Cortland & Northern, from Camden to the St. Lawrence River.

ST. CATHARINE'S, ONT.—E. A. C. Pew is promoting the electric railway scheme across the northwestern portion of Ontario, from Port Perry to Lake Huron. A charter will be applied for at the present session of Parliament, and, if obtained, will be passed over to a New York company which proposes to build the road without asking for bonuses or government assistance.

BROCKTON, MASS.—Several well-known residents of this city, including Hon. W. L. Douglas, ex-Mayor Whipple and ex-Aldermen Merritt, and others, have organized the Brockton, Bridgewater & Taunton Street Railway Company to construct a railway from the Montello Railway station through Brockton, West Bridgewater, Raynham and Taunton. The road will be 18 miles long.

HARRISBURG, PA.—A charter has been granted to the Millersburg & Brookside Railway Company, for a line to be 23 miles in length, forming a connection from the Northern Central Railway at Millersburg to a point near Brookside. W. B. Schofield, of Camden, N. J., John A. Barry, A. J. County, H. T. Witkins and Alfred C. Heston, of Philadelphia, and H. P. Connor, of Radnor, are interested.

BLOOMFIELD, N. J.—The Township Committee, the Consolidated Traction Company, and the North Jersey Street Railway Company came to an agreement under which the North Jersey Company will be in a position to operate its road in Glen Ridge to the Montclair line at once. The Town Committee granted the company the privilege to extend its trolley wire, but not its tracks, from the borough line to the Liberty Street terminus of the Consolidated Traction Company's lines, and also granted the privilege to the Consolidated Traction Company to supply electric power to the North Jersey Company within the township limits.

Trade and Industrial Notes.

THE CANTON STEEL COMPANY, Canton, O., has recently received an order for the corrugated arches to be used in the building of the York Manufacturing Company, at York, Pa., for executing which class of work the Canton Company has exceptional facilities.

HOW TO USE PLUMBAGO CRUCIBLES.—In a four-page pamphlet, the Joseph Dixon Crucible Company, of Jersey City, N. J., gives concise directions for the proper use of plumbago crucibles. The information is very complete, in fact, forming a compact treatise on the subject.

PITTSBURG, PA.—The Tradesmen's Bank Building, a large and handsome block being erected in Pittsburg at the present time, will be lighted by electricity from its own plant, which consists of Ball engines, built by the Ball Engine Company, Erie, Pa., direct-connected to Westinghouse dynamos.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is steadily increasing its force, and reports a bright outlook for the season's business in the fan motor line. The trade is rapidly adopting its new standard knife switches, and its alternating-current power motors are meeting a "long-felt want."

CROSBY BROS., manufacturers of electrical specialties, 44 North Fourth Street, Philadelphia, Pa., formerly Willard S. Atkinson & Co., of 1020 Hunter Street, report business with them excellent in all their lines. All of the tablet boards for the new Hotel Walton, formerly Hotel Metropole, of South Broad Street, that city, were made by them. They make a specialty of knife switches, tablet boards and switchboards.

THE DAVIS & EGAN MACHINE TOOL CO., Cincinnati, O., (formerly the Lodge & Davis Machine Tool Co,), held its first annual directors' meeting on Monday last. Chas. Davis was elected president; W. H. Burtner, vice-president and treasurer, and B. B. Quillen, secretary. A dividend of 6 per cent. was declared on the capital stock for the past six months. The new company starts out with a bright future in prospect.

THE PURITY OIL FILTER COMPANY, 211 Water Street, Pittsburg, Pa., in a 24-page catalogue, describes the "Ideal" purity oil filters, giving numerous letters from users, the tone of which are even more complimentary than is usual in testimonial letters. Among the features of the catalogue is a catechism on oil filtration, giving information in regard to the kinds of oil for different purposes, and the best methods of using the same.

THE PROCTOR RAYMOND COMPANY, successors to the Proctor Raymond Electric Company, late of Rochester, N. Y., is now established at 444 Niagara Street, Buffalo, occupying three floors aggregating 15,000 square feet. The factory is equipped with the most modern machinery. Some of the various electrical specialties manufactured by this concern are bells of all descriptions, spark coils, and push buttons. It does its own nickel plating and japanning. Mr. Proctor states that his bell business is especially good.

MAJOR A. G. POSTLETHWAITE, former controller of the St. Paul & Northern Pacific Railway and general land agent of the Northern Pacific Railway, has been elected vice-president and a director of the J. C. McNaughton Company, wholesale dealers in lumber and railway ties and line poles, of Philadelphia, to succeed Mr. Louis C. Maus, recently deceased. Major Postlethwaite, in connection with Mr. J. C. McNaughton, established the business of the J. C. McNaughton Co. in 1868, and then returned to his original business, after nearly 30 years spent in railway service with the Pennsylvania, the Erie and in the West.

THE KESTER ELECTRIC MANUFACTURING COMPANY is the firm name of a new concern recently established and located at 640 Linwood Avenue, Buffalo, N. Y. Mr. J. F. Kester the well-known inventor, is at the head of this concern. This company manufactures the "Niagara" dry battery wire cloth dynamo brushes, which are ventilated and self-lubricating, and a soldering compound in the form of a dry powder put up in pound and half-pound boxes. Eight thousand square feet of floor space is occupied by this company. Mr. Kester says that by means of an automatic machine for manufacturing his dynamo brushes, he can turn out one a minute.

THE STOREY MOTOR & TOOL COMPANY, York Street, Philadelphia, Pa., in a neat 32-page pamphlet, illustrates and describes the various forms of Storey dynamos and motors. The application of the motor to numerous uses is illustrated by well-executed wood engravings and half-tones. The advantage of this form of iron-clad motor in the workshop is well illustrated in a cut of the grinding lathe. In this case there is a grinding wheel on each end of the shaft, and the motor itself has merely the appearance of a pedestal or bearing for the shaft, the entire space occupied being no greater than that taken by the support for the usual belt pulley; the same remark applies to several buffers illustrated.

THE BERLIN IRON BRIDGE COMPANY of East Berlin, Conn., has just completed a very successful year. The shipments have been the largest in the history of the company, and is represented by over one and one half million dollars' worth of business. At the annual meeting of the stockholders, which was held at the office of the company on Thursday, Jan. 30, the following directors were elected: Chas. M. Jarvis, Burr K. Field, Geo. H. Sage, H. H. Peck of Waterbury, Conn.; S. H. Wilcox of Brooklyn, N. Y., J. W. Burr and F. L. Wilcox. At the meeting of the directors the following officers were elected: President and chief engineer, Chas. M. Jarvis; vice-president, B. K. Field; secretary, Geo. H. Sage; treasurer, F. L. Wilcox; manager of highway bridge department, D. E. Bradley; assistant to the president, E. W. Stearns.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 4, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York]

553,831. SECONDARY BATTERY; A. E. W. Boucher, Prilly, Switzerland. App. filed Aug. 13, 1895. An electric couple for secondary or storage batteries, consisting of an anode comprising one or more thin sheets of non-oxidizable precious metal, the entire perimeter of which is enclosed in a metallic frame adapted to conduct the current to said perimeter of the anode, said frame protected by a layer of insulating material from the electrolyte, and a cathode of non-precious metal surrounding the insulated frame of the anode, and supported by said frame at an invariable distance from the anode.

553,838. SUCCESSIVE NON-INTERFERENCE SIGNAL BOX; F. W. Cole, Newton, Mass. App. filed April 21, 1890. In a signal box, a signaling-train, a pull, a toothed sector, moved by said pull, combined with a pallet, having three projections on it, a bell hammer, and gong.

553,839. NON-INTERFERENCE SIGNAL BOX; F. W. Cole, Newton, Mass. App. filed March 7, 1891. In a non-interference signal box, a signaling mechanism, a non-interference magnet and its armature adapted to move out of the field of force, a signal controlled governed by said armature, and a stopping device for the train, one of the co-operating members of which is governed by said armature, and a restoring device operated by the train in running for restoring the said armature.

553,840. SUCCESSIVE NON-INTERFERENCE SIGNAL BOX; F. W. Cole, Newton, Mass. App. filed May 3, 1890. In a non-interference signal box, a train, a circuit controller for the signaling circuit, operated by it, a non-interference magnet and its armature combined with a normally combined closed shunt-switch for the said circuit controller controlled by both the train and the armature.

553,843. TELEPHONE; S. A. Dinsmore, Chicago, Ill. App. filed March 8, 1895. The combination in a telephone having a transmitter containing granulated carbon, of a call circuit operating device provided with a projection, a pivoted lever having one end in such a position as to be engaged by said projecting part when the call circuit-operating device is moved, the other end of said lever being connected with the transmitter.

553,844. INSULATING JOINT; W. O. Duntley, St. Louis, Mo. App. filed March 25, 1895. In an insulating joint, the combination of a section adapted to be secured to the gas pipe a cone at the lower end of the perforation therethrough, a second section insulated from the said first section, a collar to secure said two sections but in contact only with said second section, interior glass insulator having a drip cone at the bottom of the perforation therethrough, and fibrous insulating washers adapted to bear the strain of the parts.

553,847. ELECTRIC TRANSFORMER; W. K. Freeman, Fort Wayne, Ind. App. filed July 5, 1895. In an inductorium the combination with the coils of magnetic frame plates connected together in solid sections and having oppositely extending arms, the arms on one section having their inner edges inclined and the arms on the other section having their outer edges inclined, said inclined edges adapted to abut and form a wedging connection between the sections without lateral displacement of the sections with relation to each other.

553,857. ELECTRIC LIGHT SWITCH; H. W. Lawrence, Denver, Col. App. filed April 1, 1895. In a three-way switch the non-conductive ratchet-wheel, revolubly mounted in a suitable base and provided with three circular divisions of teeth separated by collars, each alternate tooth of each end division intermediate of the teeth of the opposite end provided with a conductive pole-piece passing through the collar adjacent to its end.

553,858. SPRING SUPPORTING EAR FOR TROLLEY WIRES; C. A. Lieb, New York, N. Y. App. filed June 23, 1894. A trolley ear comprising a bolt portion adapted to secure the ear to the insulator, a bolt therein, a body part rocking about the bolt, and sleeve adapted to secure the trolley wire in place, and a slot in the body part between the sleeve and the bolt portion.

553,873. NON-INTERFERING SIGNAL APPARATUS; J. J. Ruddick, Richmond, Ind. App. filed June 28, 1890. The combination with a signal wheel, an actuating train therefor, of a non-interference magnet in circuit therewith, a mechanical stop normally holding the armature of said magnet in its attracted position, and means for releasing said armature automatically on the starting of the train, to allow the armature freedom of action during a time longer than the longest closure in any signal.

553,900. ELECTRICAL WHISTLE CONTROLLING DEVICE; A. E. Colgate, Brooklyn, N. Y. App. filed Nov. 24, 1894. The combination of a whistle, an operating magnet and circuit, an automatic circuit-maker, an electric motor for operating it, a starting circuit-controller, at a distance therefrom, and a separate stopping circuit-controller, the latter being an at-will operating device for the whistle.

553,901. AUTOMATIC CURRENT REGULATOR; S. C. C. Currie, New York, N. Y. App. filed Feb. 20, 1895. The combination in a variable resistance of a fixed plate, a relatively movable plate, a reservoir containing liquid, in which the latter plate is movable, an expansion rod, and means operatively connecting said rod with the movable plate.

553,911. REGULATING SOCKET FOR INCANDESCENT LAMPS; A. B. Hendricks, St. Mary's, Ill. App. filed June 19, 1895. Regulator for electric lamps, consisting of a socket to receive the lamps, a hub provided with radially-extending coils of varying resistances, and stationary contact fingers arranged to close the circuit successively through the resistance-coils as they are revolved.

553,919. ELECTRIC ARC LIGHTING; G. R. Lean, Cleveland, O. App. filed Sept. 26, 1895. In a system of arc lighting the combination with a multiple arc circuit supplied with a current of constant potential of two or more arc electric lamps included in series in said multiple arc circuit, each of said lamps being provided with a main or lifting magnet.

553,920. ELECTRIC ARC LIGHTING SYSTEM; G. R. Lean, Cleveland, O. App. filed Sept. 27, 1895. In an arc lighting system, the combination with a multiple arc circuit of two or more arc lamps included in series in said multiple arc circuit, a shunt circuit around the terminals of each lamp, a resistance coil in each shunt circuit, and a reverse or differential winding on the magnet of each lamp and included in said shunt circuits in series with said resistance coils.

553,921. ELECTRIC ARC LIGHTING; G. R. Lean, Cleveland, O. App. filed Sept. 27, 1895. In an arc-lighting system, the combination with a multiple arc circuit, of two or more arc lamps each having a separate and feeding magnet included in series therein, a magnet or solenoid included in the shunt-circuit between the terminals of each lamp, the coil of each shunt magnet or solenoid being adapted to compensate for increase in voltage of the arc of the lamp between the terminals of which it is connected, contacts connected with the terminals of the separating and feeding magnet of each lamp, and an armature for said shunt-magnet or solenoid adapted to engage said contacts and short-circuit the separating and feeding magnet when the voltage of the arc increases. (See Illustration.)

553,923. APPARATUS FOR ELECTRIC WELDING; H. Lemp, Lynn, Mass. App. filed June 17, 1891. In an electric metal-working apparatus, the combination with two transformers supplying heating currents to the said work, of alternating current sources, connected respectively to the primaries of said transformers, and adapted to supply alternating currents of different frequency.

553,927. ELECTRIC TROLLEY; N. Muslar, West Boylston, Mass. App. filed April 9, 1894. The combination of a central spindle held from rotation, a cylindrical block pivoted on said spindle so as to be capable of a laterally rocking or oscillating motion, and having a peripheral groove, and a wheel journaling on said block and engaging said groove.

553,952. ELECTRIC RAILWAY; A Casazza, Hoboken, N. J. App. filed Dec. 13, 1894. In an electric railway, the combination of a generator, a feed-wire, a conduit having a slotted top, a line wire composed of sections having their ends insulated, and mounted on raised supports in the conduit, switch devices adapted when actuated to place the feed-wire in circuit with the sections of the line wire, said switch devices each comprising a magnet and its armature, a car having a motor circuit, including a trolley arm having a trolley adapted to traverse the sections of the line wire.

553,957. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed July 25, 1891. The combination of a main line, a source of electrical energy for signaling a transmitter, controlling contacts normally connecting said main line to earth, contacts controlled by said transmitter for sending signals into said main line, other contacts controlled by said transmitter for locally actuating a relay, an electromagnetic instrument actuated by said relay, and contacts controlled by said electromagnetic instrument for connecting said main line to earth each time that a signal is transmitted.

553,960. ELECTRICAL IGNITING DEVICE; W. Kaiser, Vienna, Austria-Hungary. App. filed Sept. 6, 1895. In an electric igniting device, the combination of a base, supported above the base, means for creating a spark, between the contiguous ends of the points, guides arranged at the upper side of the base, a slide arranged between the guides, a light-giving device carried by the slide, and adapted to be lighted by the spark.

553,964. REGISTERING APPARATUS FOR TELEPHONES; F. Quatram, Pankow, Germany. App. filed July 26, 1895. In a registering apparatus for telephones, the combination of a battery, a commutator, in circuit with the battery, a registering device actuated by the commutator, an electro-magnet in circuit with the commutator, and with the telephone, a switch for breaking and closing the circuit, between the commutator and the electromagnet, and a magnetic switchbar actuated by the electromagnet.

553,977. ADJUSTING ATTACHMENT FOR TELEPHONE SIGNAL BELLS; C. F. Dunderdale, Chicago, Ill. App. filed June 27, 1895. An adjusting attachment for telephone signal bells, consisting of a holding member comprised of two separable parts, overlapping each other and slidably held upon the telephone box, until the proper adjustment is effected, bell gongs held and carried by said separate parts, a bell striker between said gongs, said separate parts being capable of lateral sliding movements carrying the gongs toward or away from the striker.

553,970. ELECTRIC RAILWAY; F. C. Esmond, Brooklyn, N. Y. App. filed April 19, 1893. In an electric railway, a case for magnetic circuit-closing devices, consisting of a base of insulating material located when the base is in position for use below the street level, means for attaching the base to a foundation, a socketed contact piece of conducting material embedded in the base for receiving the terminal of the main conductor, a dome-shaped top of conducting material attached to said base, and a flange upon said top projecting beyond the base and supported independently of the foundation of the base.

553,980. ELECTRIC RAILWAY; F. C. Esmond and H. F. Gray, of Brooklyn, N. Y., and Passaic, N. J. App. filed May 4, 1893. In an electric railway system, the combination with an insulated supply conductor and an exposed conductor of a circuit-closing device comprising a low-resistance coil located in series between such conductors, and normally out of circuit, a coil of high resistance in a permanently closed circuit independent of the motor circuit, a movable core located within said coils, and contact pieces carried by said core, and adapted to close the circuit through said low-resistance coil

553,981. CIRCUIT CONTROLLING DEVICE FOR ELECTRIC RAILWAY SYSTEMS; F. C. Esmond, Brooklyn, N. Y. App. filed July 1, 1893. The

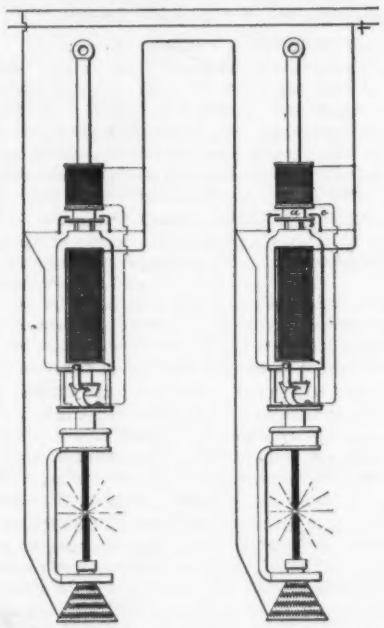
combination in an electric railway of a supply conductor with a series of enclosed switch boxes, the covers of which constitute sections of a sectional working conductor normally insulated from the supply conductor, with a switch and electromagnet housed in a box, each electromagnet comprising two coils, a low-resistance coil joined at one terminal to the conducting cover of the box, and adapted to be connected at the other terminal to the supply conductor by the switch, and a high-resistance coil permanently grounded at one end and forming a circuit between the ground and a switch-controlling section, in the rear of the corresponding switch box.

554,016. PRESSURE ALARM FOR GAS SUPPLY PIPES TO FURNACE; F. S. Baker, Chicago, Ill. App. filed July 22, 1895. The combination with a furnace or gas-burning device, and its supply pipe, of an electric circuit, an alarm device included in the circuit, a bent tube containing mercury communicating at one end with the gas supply pipe, electric terminals or contact pieces connected with said circuit and between which the circuit is closed by the mercury in said bent tube when acted upon by a change of pressure in the gas supply pipe, and a pressure regulating or equalizing reservoir or vessel inserted between said gas supply pipe, and said bent tube.

554,036. TELEPHONE APPARATUS; C. J. Schwarze, Adrian, Mich. App. filed Sept. 17, 1895. In a telephone, the combination with a magneto-electric generator for signaling of two vibratory diaphragms, forming respectively parts of the opposite poles of the generator magnet to which they are connected, and in conjunction with the armature of said generator, constituting the transmitter and receiver.

554,042. FUSE BOX; J. S. Strouse, Baltimore, Md. App. filed Oct. 5, 1895. In a fuse box having two fusible wires in electric circuits, a clamp for each wire combined with a single spring to place a tension on both clamps.

554,043. ELECTRIC BATTERY; D. S. Williams and H M. Hamrick, Philadelphia, Pa. App. filed May 15, 1895. In an electric battery, the combination with a zinc electrode of an electrode composed of a series of superposed perforated blocks of active material, plates of lead, similarly perforated, interposed between the various blocks, a conducting strip, and flexible connections between said strip and plates, and supporting rod extending through the central openings of said blocks and plates.



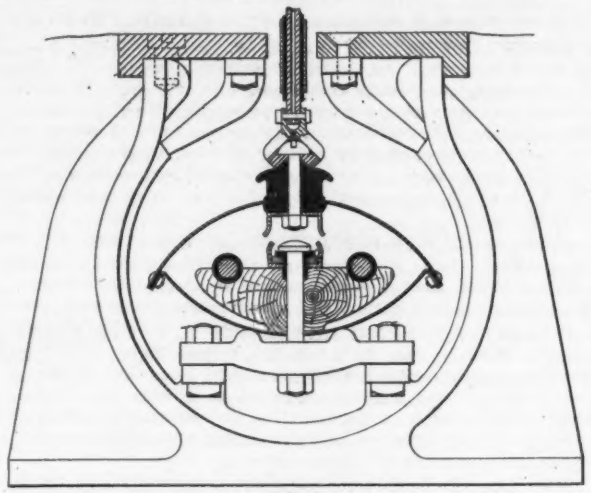
No. 553,921.—Electric Arc Lighting.

554,063. COMMUTATOR FOR MAGNETO-ELECTRIC MACHINES; J. C. Henry, Westfield, N. J. App. filed Dec. 16, 1891. A commutator for a magneto-electric machine having the radial arms of its alternate segments surrounded with insulation.

554,074. ELECTRICAL CIRCUIT CLOSER; L. B. Miller, Elizabeth, N. J. App. filed Aug. 3, 1895. An electrical circuit closer, comprising a casing of equal width with and adapted to attachment to the parting strip of a window-frame, the said casing being formed of plate, with side flanges along the edges of one of its faces, having in each an aperture between the middle and one of its ends, and disposed upon opposite sides of the middle of the casing a flat switch lever, secured movably within the said casing at one edge by a pivotal pin projection from the corresponding edge of the said plate intermediate to the apertures in its side flanges, and notched upon opposite edges intermediate to the middle and each end to form heads projected normally through the said apertures without the casing, and an insulated contact point fixed to the said casing in the path of the said switch lever.

554,080. AUTOMATIC SWITCH; J. F. McElroy, Albany, N. Y. App. filed Jan. 2, 1892. In an automatic switch, the combination with two armature bars, a central pivotal connection between the bars, and means for fixedly securing one of the bars, a coil on both bars, laterally-extending armatures on the opposite ends of the bars, those adjacent arranged to act upon each other, fixed contacts, and contacts carried by the opposite ends of the movable bar.

554,089. ELECTRIC CARRIAGE LAMP; P. H. Quinn, New York, N. Y. App. filed Dec. 3, 1895. An electric light consisting of a socket provided with bottom springs for retaining the socket in the cup or cone of the candle-holder of the lamp, a spring-cushioned lamp-holder supported on said socket, means for locking the socket to the cup, or cone of the candle-holder, an incandescent lamp inserted in the lamp-holder and provided with the usual metallic contacts, and conducting wires attached to the lamp-holder, and connected with the contacts of the same, said conducting wires being adapted to communicate with a suitable source of electricity.



No. 554,104.—Underground System for Electric Railways.

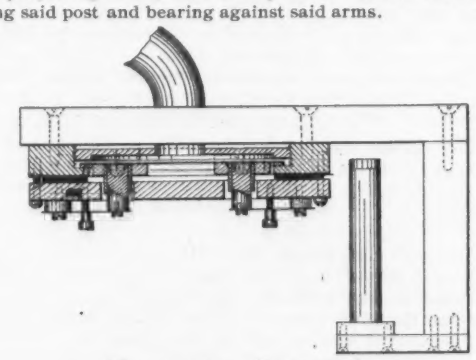
554,097. APPARATUS FOR RAILWAY SIGNALING AND SWITCHING; J. D. Taylor, Chillicothe, O. App. filed Oct. 29, 1891. In electric railway switching and signaling apparatus the combination with interlocking and switch-operating mechanism, a generator and suitable electrical connections, of a reversing electric switch consisting of pivoted bars having arms of tappets affixed, two pairs of contacts for said bars, and a rotatable cam mechanism for acting on said arms to automatically shift the bars from one pair of contacts to another.

554,102. UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS; W. P. Allen, Chicago, Ill. App. filed June 22, 1895. In an electric railway system a conductor formed in sections, each section consisting essentially of an outer flexible metallic casing, and an inner metallic core, insulating blocks at each end of said metallic casing, adapted to close the same and form a continuation of said metallic core.

554,103. ELECTRIC CONDUCTOR AND CONTACT DEVICE THEREFOR; W. P. Allen, Chicago, Ill. App. filed July 15, 1895. The combination with an outer casing having the slotted rail or cover, a flexible diaphragm within said casing adapted to divide the same horizontally so as to form upper and lower compartments, one of said compartments being continuous, while the other is divided into sectional water-tight compartments, a conductor below said diaphragm and extending through the various water-tight compartments, and a sectional rail above said diaphragm composed of insulator sections, and contacting devices between said rail and conductor, said contacting devices being located within said water-tight compartment.

554,104. UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS; W. P. Allen and A. S. Krotz, Springfield, O. App. filed Aug. 23, 1895. The combination with the supporting yoke insulators therein, the elliptical metallic casing having an insulated support for the conductors, which extend through the same, said casing being closed at each end, and having therein a number of contacting devices, an electrical connection, including a switch from one of said conductors to said contacting devices, an insulated rail supported on said casing, and an electrical connection extending through said casing to a movable contact, arranged adjacent to each of said contacting devices and means for depressing said rail to establish an electrical connection between said contracting devices and thus with said rail. (See Illustration.)

554,112. TELEGRAPH KEY; W. Deats, Amawalk, N. Y. App. filed June 16, 1894. In a telegraph transmitter the combination of a single post having laterally-projecting arms, and a key lever located below said arms straddling said post and bearing against said arms.



No. 554,141.—Telephone.

554,141. TELEPHONY; C. A. Randall, London, England. App. filed Dec. 31, 1894. A telephone transmitter characterized by a single diaphragm in electric contact through the medium of interposed carbon granules or similar material, with and actuating two or more electrodes, insulated from and independent of each other, arranged to conduct the current from two or more independent batteries to the diaphragm in electric contact therewith, and the return circuit to the batteries.